RAILROAD GAZETTE

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THE RAILROAD GAZETTE.

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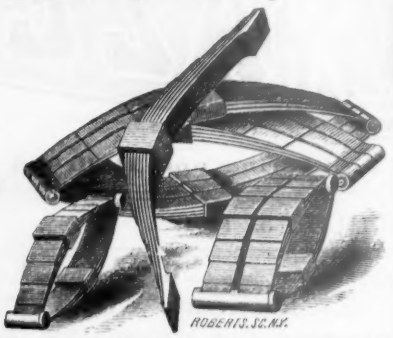

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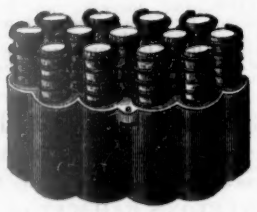

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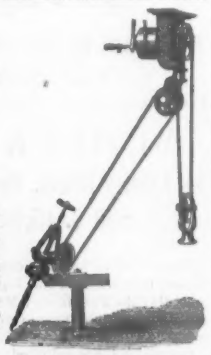

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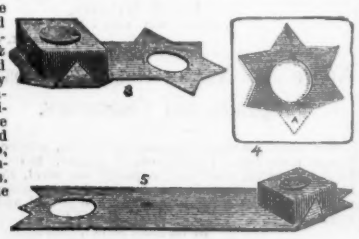

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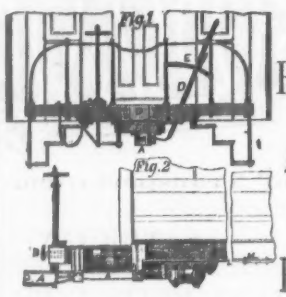

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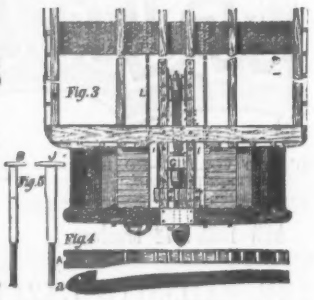

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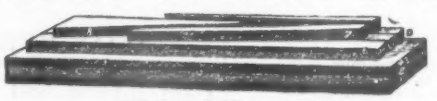

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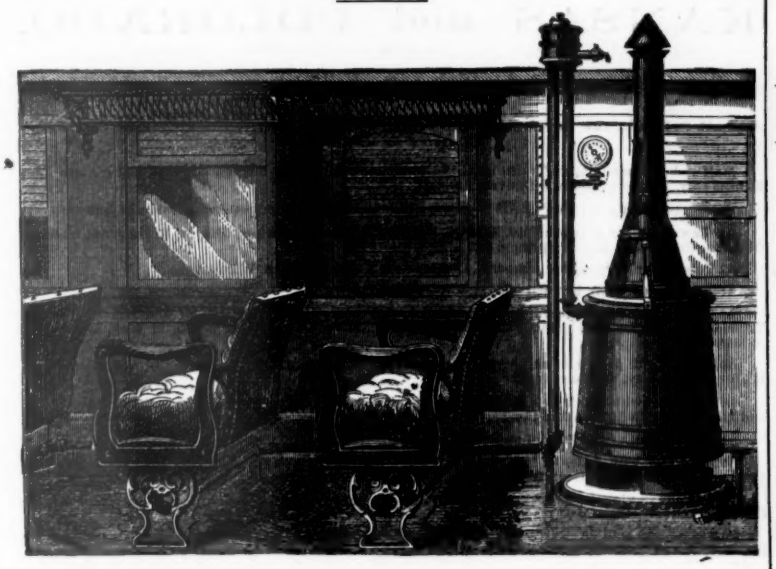

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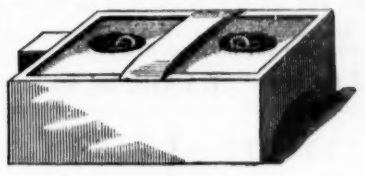

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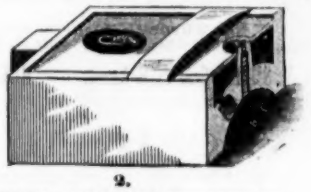

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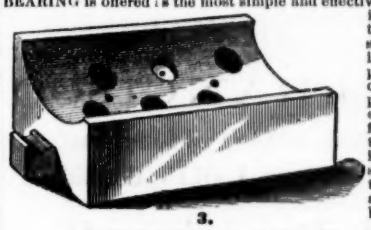

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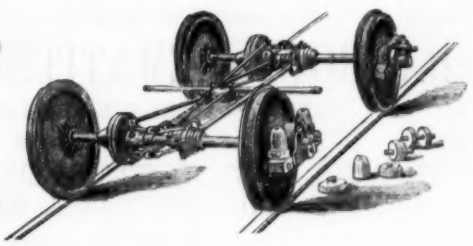

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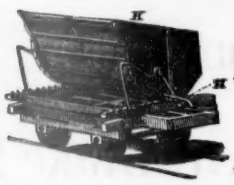

Fig. 1.—Car Loaded and at Rest.

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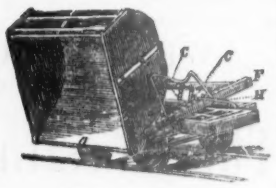

Fig. 2.—Car Dumped.

TO DUMP THE CAR.—The Brakeman seizes the lever, H, and raises it about a foot, thus releasing the box from the catch, C, and the rocker-frame, F, from the catch, C, when the box, K, yields with the force of gravity and rolls over to the position shown in Fig. 2

To Replace the Box in Readiness for Another Load.—The brakeman bears his weight on the up-end of the rocker-frame, F, forcing it down to its place, when the box rolls back to its place, where it is held by the catches, C and C.

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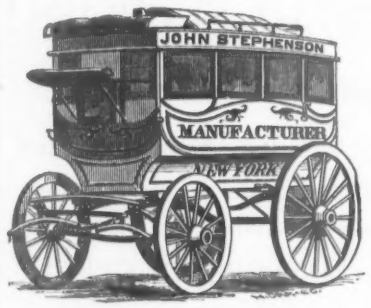

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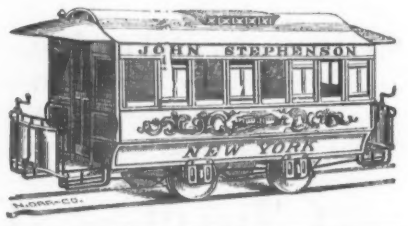

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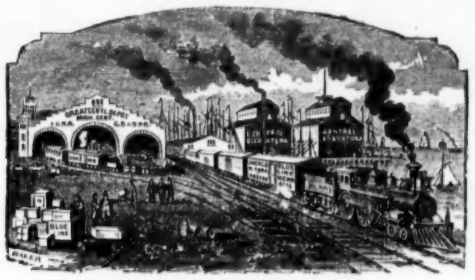
1871.  1871.

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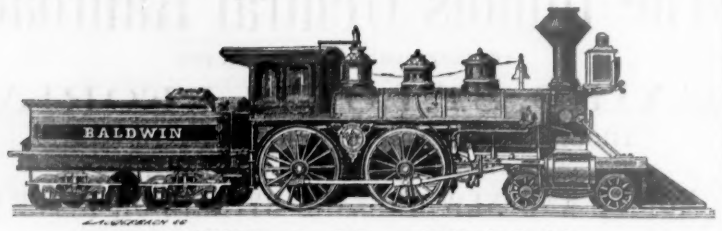

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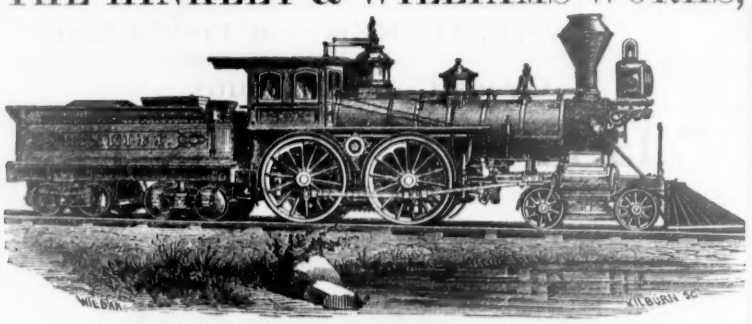

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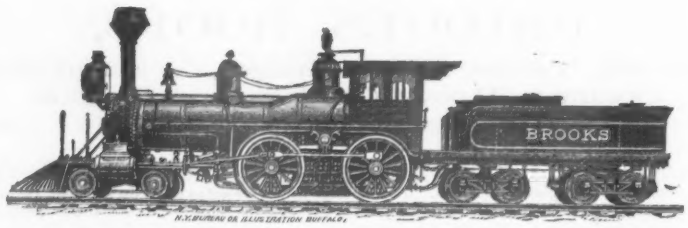

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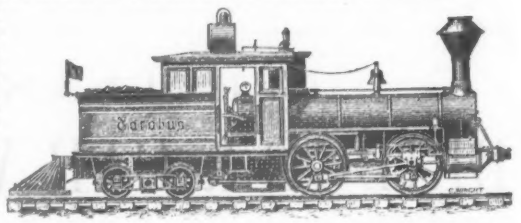

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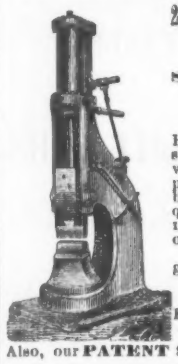

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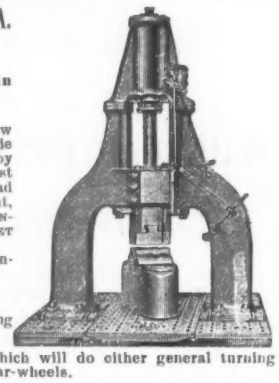

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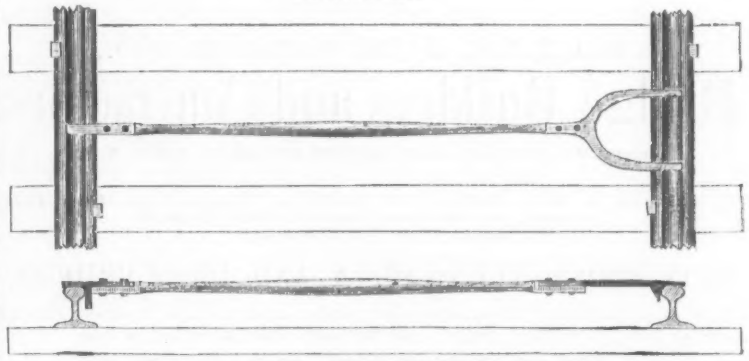

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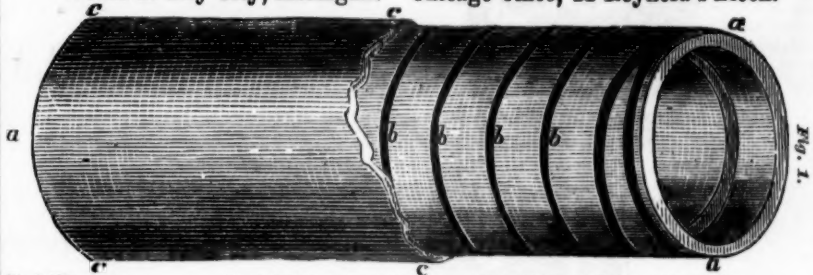

Fig. 1. View of Pipe. *a a.* Cylinder of Wood. Fig. 2. Thimble for Connection. *b b.* Bands of Iron. Fig. 3. Horizontal Section and Connection. *c c.* Coating of Hydraulic and Asphaltum Cement.

ABOVE is a profile of the "Wyckoff Patent Gas and Water Pipe," manufactured by the Northwestern Gas and Water Pipe Co. This pipe, used for Water and Gas Mains, has been in use in the States of New York, New Jersey, Pennsylvania and Ohio several years, and is now being used by most of the leading lines of railroad in the West for conveying water to their tanks for the supply of engines and also round-houses. This pipe can be made to bear any pressure that is required of iron for the same purpose, and costs much less than any other kind. This pipe is made any required size, of pine or tamarac, in sections eight feet long, rounded in a *lathe*, and connected with a socket and thimble joint, perfectly air and water tight, is used for suction or pumping through, and can be easily and rapidly laid by any ordinary workman, being driven together without cement. It can be tapped and connected with branch pipes more easily than other kinds. This pipe being completely encased in a coating of aphaltum, is shielded from contact with air and the constant flow of water through the inside makes it imperishable. Before coating, this pipe is banded spirally with iron of such weight as the required strength may demand, and combining durability, strength and cheapness, is considered the best water-main in use for cities and villages for conveying water to railroad tanks, and for water courses of every kind.

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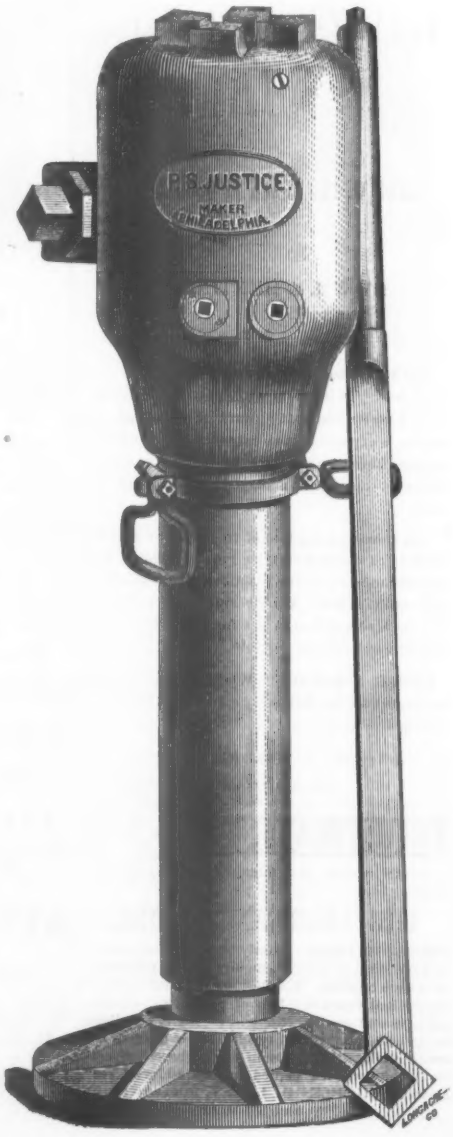

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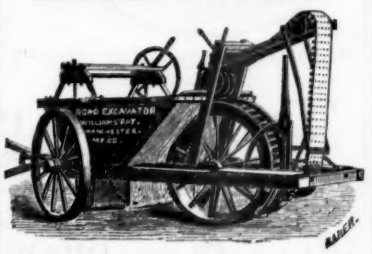

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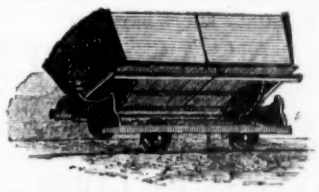

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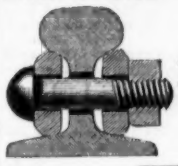

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—FOR—

Atchison, Leavenworth, Kansas City, Lawrence, Topeka,

MEMPHIS, NEW ORLEANS,

And All Points South and Southwest.

☞ TRAINS leave Chicago from the West-side Union Depot, near Madison Street Bridge. ☜

	Depart.	Arrive.
Express Mail	*9:15 A. M.	*8:00 P. M.
Joliet Accommodation	*4:10 P. M.	*9:40 "
Night Express	*6:00 "	*12:50 "
Lightning Express	‡9:00 "	*7:15 A. M.

* SUNDAYS Excepted. ‡ SATURDAYS Excepted.

The only road running trains through to St. Louis Saturday nights and making the time in 11 hours

This is the Only Line between Chicago & St. Louis running

Pullman Palace Sleeping and Celebrated Dining Cars!

BAGGAGE CHECKED THROUGH.

Through Tickets can be had at the Company's office, No. 55 Dearborn street, Chicago, or at the Depot, corner of West Madison and Canal streets, and at all principal Ticket Offices in the United States and Canada. Rates of Fare and Freights as low as by any other Route.

JAS. CHARLTON, Gen. Pass. Agt. JAS. SMITH, Gen. Fr't Agt. J. C. McMULLIN, Gen. Supt.

MISSOURI PACIFIC R. R.

THE MOST DIRECT AND RELIABLE ROUTE FROM

St. Louis through to Kansas City, Leavenworth & Atchison

☞ WITHOUT CHANGE OF CARS! ☜

Close Connections at Kansas City for Lawrence, Topeka, Junction City, Denver, San Francisco, St Joseph, Nebraska City, Omaha, Humboldt, Neosho Falls, and all points in

KANSAS, COLORADO AND CALIFORNIA.

☞ At SEDALIA with Missouri, Kansas and Texas Railroad for Ft. Scott, Baxter Springs and all points in Southwest Missouri, Indian Territory and Texas.

Palace Sleeping Cars on All Night Trains!

BAGGAGE CHECKED THROUGH FREE.

THROUGH TICKETS for sale at all the Principal Railroad Offices in the United States and Canadas. **Be Sure and Get your Tickets over the PACIFIC R. R. OF MISSOURI.**

W. B. HALL, Gen. Pass. and Ticket Agt.
I. G. WHEELER, Gen. N. E. Pass. Agt., Chicago.
THOS. McKISSOCK, General Superintendent.

TAYLOR BROS. & CO.

Cast Steel Locomotive Tyres,

BEST YORKSHIRE BAR IRON

— AND —

BOILER PLATES.

This Iron is unequaled for strength and durability, soundness and uniformity It is capable of receiving the highest finish, which renders it peculiarly adapted to the manufacture of Locomotive and Gun Parts, Cotton and other Machinery Chain Bolts, &c.

Sole Agency for the United States and Canadas.

Taylor Iron Works,

HIGH BRIDGE, N. J.

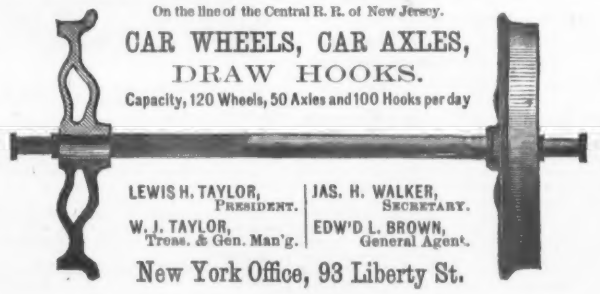
On the line of the Central R. R. of New Jersey.

CAR WHEELS, CAR AXLES,

DRAW HOOKS.

Capacity, 120 Wheels, 50 Axles and 100 Hooks per day

WHEELS AND AXLES, made in the best and most careful manner, furnished separately, or "fitted," making complete sets.



STANDARD DRAW HOOKS, finished, ready for immediate use, with nuts and plates, with or without links.

LEWIS H. TAYLOR, President. | JAS. H. WALKER, Secretary.
W. J. TAYLOR, Treas. & Gen. Man'g. | EDW'D L. BROWN, General Agent.

New York Office, 93 Liberty St.

ILLINOIS CENTRAL RAILROAD.

PASSENGER TRAINS LEAVE CHICAGO FROM THE GREAT CENTRAL DEPOT, FOOT OF LAKE ST.

St. Louis and Chicago THROUGH LINE.

NO CHANGE OF CARS FROM CHICAGO TO ST. LOUIS!

9:20 A.M. **DAY EXPRESS** Sundays Ex.
Arriving in ST. LOUIS at 10:45 P. M.

8:10 P.M. **FAST LINE.** Saturdays Excepted.
Arriving at ST. LOUIS at 7:40 A. M.

At ST. LOUIS, Direct Connections are made for

JEFFERSON CITY, SEDALIA, PLEASANT HILL, MACON,

KANSAS CITY, LEAVENWORTH, ST. JOSEPH & ATCHISON.

—Connecting at KANSAS CITY for—

LAWRENCE, TOPEKA, JUNCTION CITY, SALINA, SHERIDAN,

Denver and San Francisco!

CAIRO, MEMPHIS & NEW ORLEANS LINE.

NO CHANGE OF CARS FROM CHICAGO TO CAIRO!

9:20 A.M. **CAIRO MAIL,** Sundays Excepted.
Arriving at **Cairo** 3:30 A. M., **Memphis** 3:05 P. M., **Mobile** 10:00 A. M. **Vicksburg** 9:45 A. M., **New Orleans** 12:30 P. M.

8:10 P.M. **CAIRO EXPRESS,** Except Saturdays.
Arriving at **Cairo** 3:30 P. M., **Memphis** 2:15 A. M., **Little Rock** 7:30 P. M., **Vicksburg** 7:10 P. M., **New Orleans** 10:30 P. M.

5:15 P.M. **EFFINGHAM PASS.** Except Sundays.
Arriving at **Champaign** at 11:45 P. M., **Effingham** 10:00 A. M.

11:00 P.M. **KANKAKEE PASS.** Except Sundays.
Arriving at **Kankakee** at 1:55 A. M.

THIS IS THE ONLY DIRECT ROUTE TO

Humboldt, Corinth, Grand Junction, Little Rock, Hot Springs, Selma,

Canton, Grenada, Columbus, Meridian, Enterprise,

MEMPHIS, VICKSBURG, NEW ORLEANS AND MOBILE.

At NEW ORLEANS, connections are made for

GALVESTON, INDIANOLA,
And all Parts of Texas.

NOTICE!—This Route is from 100 to 150 MILES SHORTER, and from 12 to 24 HOURS QUICKER than any other.

THIS IS ALSO THE ONLY DIRECT ROUTE TO

DANVILLE, DECATUR, TERRE HAUTE, VINCENNES, EVANSVILLE, SHAWNEETOWN, PANA AND VANDALIA.

PEORIA & KEOKUK LINE.

5:15 P.M. **KEOKUK PASSENGER,** Sun. Excepted.
Arriving at **Chenoa** 11:50 P. M., **El Paso** 12:35 A. M., **Peoria** 2:00 A. M., **Canton** 3:35 A. M., **Bushnell** 4:50 A. M., **Keokuk** 7:12 A. M., **Warsaw** 7:40 A. M.

Elegant Drawing-Room Sleeping Cars!
ATTACHED TO ALL NIGHT TRAINS.

Spacious and Fine Saloon Cars!

With all Modern Improvements, Run upon all Trains.

BAGGAGE CHECKED THROUGH TO ALL IMPORTANT POINTS.

☞ For Through Tickets, Sleeping-Car Berths, Baggage Checks, and information, apply at the office of the Company in the Great Central Depot, foot of Lake St.

HYDE PARK & OAKWOODS TRAIN.

	Leave.	Arrive.		Leave.	Arrive.
CENTRAL DEPOT....	*6:15 A. M.	*7:47 A. M.	CENTRAL DEPOT....	*5:15 P. M.	*5:15 P. M.
" "	*9:45 "	*9:00 "	" "	*6:10 "	*7:35 "
" "	*12:10 P. M.	*11:00 "	" "	*11:00 "	
" "	*8:00 "	*1:45 P. M.			

* *Sundays Excepted.*

WM. P. JOHNSON, Gen. Passenger Agent.

Chicago & Northwestern R.W.

Comprising the Principal Railroads from Chicago, DIRECTLY NORTH, NORTH-WEST and WEST.

ALL RAIL TO THE PACIFIC OCEAN!

GREAT CALIFORNIA LINE.

TRAINS LEAVE WELLS STREET DEPOT AS FOLLOWS:

8:30 A. M. Clinton Passenger.
10:45 A. M. Pacific Express.
10:45 A. M. Rock Island Express.
9:45 P. M. Night Mail.
9:45 P. M. Rock Island Passenger.
4:00 P. M. Dixon Passenger.

For Sterling, Rock Island, Fulton, Clinton, Cedar Rapids, Boone, Denison, Missouri Valley Junction, Sioux City, Council Bluffs and Omaha, there connecting with the

Union Pacific Railroad,

For Cheyenne, Denver, Ogden, Salt Lake, the White Pine Silver Mines, Sacramento, San Francisco, and all parts of Nebraska, Colorado, New Mexico, Arizona, Wyoming, Montana, Idaho, Utah, Nevada, and the PACIFIC COAST.

FROM CHICAGO	Hours.	1st Class Fare.	FROM CHICAGO	Days.	1st Class Fare.
To OMAHA,.....	23	$19.80	To SACRAMENTO,.	4½	$118.00
" DENVER,.....	52	63.00	" SAN FRANCISCO,	5	118.00

TRAINS ARRIVE:—Night Mail, 6.30 a. m.; Dixon Passenger, 11.10 a. m.; Pacific Express 3:15 p. m.; Rock Island Express, 4:15 p. m.; Clinton Passenger, 6:45 p. m.

FREEPORT LINE.

9.00 A. M. & 9.00 P. M. For Belvidere, Rockford, Freeport, Galena, Dunleith, and St. Paul.

12:00 Noon, Maywood Passenger; 1:45 P. M. return.
4:00 P. M., Rockford Accommodation.
5:15 P. M., Geneva and Elgin Accommodation.
6:10 P. M., Lombard Accommodation.
5:30 P. M., Junction Passenger.

TRAINS ARRIVE:—Freeport Passenger, 2:30 p. m., 7:15 a. m.; Rockford Accommodation, 11:10 a. m.; Geneva and Elgin Accommodation, 8:45 a. m.; Junction Passenger, 8:30 a. m.; Lombard Accommodation, 6:50 a. m.

WISCONSIN DIVISION.

☞ Trains leave Depot, cor. West Water and Kinzie Sts., daily, Sundays excepted, as follows:

9:00 A. M., Barrington Passenger; 5:15 P. M. return.

10.00 A. M. **DAY EXPRESS,** for Janesville, Monroe, Whitewater, Madison, Prairie du Chien, Watertown, Minnesota Junction, Portage City, Sparta, La Crosse, St. Paul, and ALL POINTS ON THE UPPER MISSISSIPPI RIVER; Ripon, Berlin, Fond du Lac, Oshkosh Neenah, Appleton, and Green Bay.

3.00 P. M., Janesville Accommodation.

5.00 P. M. **NIGHT EXPRESS,** for Madison, Prairie du Chien, Watertown, Minnesota Junction, Portage City, Sparta, La Crosse, St. Paul, and ALL POINTS ON THE UPPER MISSISSIPPI RIVER; Ripon, Berlin, Fond du Lac, Oshkosh, Menasha, Appleton, Green Bay, and THE LAKE SUPERIOR COUNTRY.

5:30 P. M., Woodstock Accommodation.
6:15 P. M., Barrington Passenger; 7:45 A. M. return.

TRAINS ARRIVE:—5:30 a. m., 7:15 p. m., 8:45 a. m., and 12:50 p. m.

MILWAUKEE DIVISION.

Milwaukee Mail	8:00 A. M.
Express (ex. Sun.) Waukegan, Kenosha, Racine and Milwaukee	9:45 A. M.
Highland Park Accommodation	1:00 P. M.
Highland Park Passenger	6:20 P. M.
Milwaukee Acnommodation with Sleeping Car attached	11:00 P. M.
Kenosha Accommodation (Sundays excepted) from Wells St. Depot	4:10 P. M.
Afternoon Passenger	5:00 P. M.
Waukegan Accommodation (except Sundays) from Wells St. Depot	5:30 P. M.

TRAINS ARRIVE:—Night Accommodation, with Sleeping Car, 5:00 a. m.; Day Express, 4:00 p. m. Milwaukee Mail, 10:10 a. m.; Afternoon Passenger, 7:40 p. m.; Waukegan Accommodation, 8:25 a. m.; Kenosha Accommodation, 9:10 a. m.; Highland Park Accommodation, 3:40 p. m.; Highland Park Passenger, 7:55 p. m.

Pullman Palace Cars on all Night Trains.

THROUGH TICKETS Can be purchased at all principal Railroad Offices East and South, and in Chicago at the southeast corner of Lake and Clark Streets, and at the Passenger Stations as above.

H. P. STANWOOD, General Ticket Agent.
JOHN C. GAULT, General Superintendent.

Milwaukee & St. Paul Railway.

THE ONLY ALL RAIL LINE TO

ST. PAUL & MINNEAPOLIS!

AND ALL PORTIONS OF

Wisconsin, Minnesota and Northern Iowa.

PURCHASE TICKETS VIA MILWAUKEE.

Passengers Going via Milwaukee,

HAVE CHOICE OF SEATS IN CLEAN COACHES, AND ON NIGHT TRAINS A FULL NIGHT'S REST IN PALACE SLEEPING CARS.

☞ BAGGAGE CHECKED THROUGH BY THIS ROUTE ONLY! ☜

Passengers from Chicago can obtain these Advantages only by the Milwaukee Division of the Chicago & Northwestern Railway

SPECIAL NOTICE.—PASSENGERS DESTINED TO ANY PLACE IN WISCONSIN, MINNESOTA, OR NORTHERN IOWA, EITHER ON OR OFF THE LINES OF THIS COMPANY, WHO CANNOT PROCURE THROUGH TICKETS TO THEIR DESTINATION, SHOULD PURCHASE THEIR TICKETS TO MILWAUKEE, AS THIS IS THE GREAT DISTRIBUTING POINT FOR THESE STATES.

A. V. H. CARPENTER, Gen. Pass. Agt. Milwaukee.
S. S. MERRILL, Gen. Manager, Milwaukee.

61 Miles the Shortest Line!

— FROM —

CHICAGO TO NEW YORK.

Pitts., Ft. Wayne & Chicago

— AND —

PENNSYLVANIA CENTRAL

IS THE ONLY ROUTE

Running its Entire Trains THROUGH to PHILADEPHIA and NEW YORK, and the ONLY ROUTE Running THREE DAILY LINES OF PULLMAN DAY and SLEEPING PALACES, from Chicago to

PITTSBURGH, HARRISBURG,

Philadelphia and New York,

☞ WITHOUT CHANGE! ☜

WITH BUT ONE CHANGE TO

BALTIMORE, PROVIDENCE, NEW HAVEN, HARTFORD, SPRINGFIELD, WORCESTER AND BOSTON!

AND THE MOST DIRECT ROUTE TO WASHINGTON.

Trains Leave **WEST SIDE UNION DEPOT**, corner West Madison and Canal Streets, as follows:

		Mail.	Fast Express.	Pacific Exp.	Night Exp.
Leave	CHICAGO	5.30 A. M.	9.00 A. M.	5.15 P. M.	9.00 P. M.
Arrive	PLYMOUTH	9.45 "	11.53 "	8.45 "	12.30 A. M.
"	FORT WAYNE	12.25 P. M.	1.55 P. M.	11.20 "	3.05 "
"	LIMA	3.07 "	3.58 "	1.37 A. M.	5.15 "
"	FOREST	4.27 "	4.58 "	2.50 "	6.35 "
"	CRESTLINE	6.00 "	6.15 "	4.20 "	8.20 "
Leave	CRESTLINE	12.00 M.	6.35 "	4.30 "	8.55 "
Arrive	MANSFIELD	12.37 P. M.	7.02 "	5.00 "	9.28 "
"	ORRVILLE	2.52 "	9.00 "	6.58 "	11.43 "
"	ALLIANCE	4.40 "	10.30 "	8.30 "	1.25 P. M.
"	PITTSBURGH	8.30 "	1.25 A. M.	12.10 P. M.	5.30 "
	CRESSON	1.54 A. M.	6.03 A. M.	4.48 P. M.	8.28 "
"	ALTOONA	2.30 "	6.50 "	5.35 "	9.15 "
"	HARRISBURG	6.18 "	11.15 A. M.	10.35 P. M.	3.45 A. M.
"	PHILADELPHIA	10.20 "	3.15 P. M.	3.10 A. M.	7.55 "
"	NEW YORK, VIA MANTUA JUNCTION	1.15 P. M.	6.00 "	6.41 "	11.30 "
"	NEW YORK, VIA ALLENTOWN				11.30 "
"	BALTIMORE	9.45 A. M.	2.40 "		7.25 "
"	WASHINGTON	1.10 P. M.	6.25 "		10.00 "
"	BOSTON	11.30 "	5.50 A. M.	5.05 P. M.	9.05 P. M.

BOSTON AND NEW ENGLAND PASSENGERS WILL FIND THIS ROUTE ESPECIALLY DESIRABLE, AS IT GIVES THEM AN OPPORTUNITY OF SEEING THE FINEST VIEWS AMONG THE ALLEGHANY MOUNTAINS,

Besides Visiting PITTSBURGH, PHILADELPHIA and NEW YORK, without extra cost!

☞ All New England Passengers holding Through Tickets will be Transferred, with their Baggage, to Rail and Boat Connections in NEW YORK, **Without Charge!**

THROUGH TICKETS for sale at the Company's Offices, at 65 Clark St.; 52 Clark St; cor. Randolph and LaSalle Sts.; and at Depot, Chicago. Also at Principal Ticket Offices in the West.

CLOSE CONNECTIONS Made at LIMA for all Points on the Dayton & Michigan and the Cincinnati, Hamilton & Dayton Railways, and at CRESTLINE for Cleveland and Columbus.

Express Trains are Equipped with WESTINGHOUSE AIR BRAKES,

The Most Perfect Protection Against Accidents in the World!

F. R. MYERS, Gen. Pass. & Tkt Agt. P. F. W. & C. R'y, Pittsburgh.

W. C. CLELAND, Asst. Gen. Pass. Agt. P. F. W. & C. R'y, Chicago.

J. N. McCULLOUGH, General Manager.

Broad Gauge! Double Track!

ERIE RAILWAY.

FOUR EXPRESS TRAINS DAILY!

From SUSPENSION BRIDGE, NIAGARA FALLS, CLEVELAND, DUNKIRK and BUFFALO, to NEW YORK, Without Change!

☞ The Trains of this Railway are run in DIRECT CONNECTION WITH ALL WESTERN AND SOUTHERN LINES, for

ELMIRA, WILLIAMSPORT, OSWEGO, GREAT BEND, SCRANTON, NEWBURGH,

NEW YORK, ALBANY, BOSTON, PROVIDENCE,

AND PRINCIPAL NEW ENGLAND CITIES.

New and Improved **DRAWING ROOM COACHES** are attached to the DAY EXPRESS Running **THROUGH TO NEW YORK.**

☞ **SLEEPING COACHES,** Combining all Modern Improvements, with perfect Ventilation and the peculiar arrangements for the comfort of the Passengers incident to the BROAD GAUGE, accompanying all night trains to New York.

CONNECTIONS CERTAIN! as Trains on this Railway will, when necessary, wait from one to two hours for Western trains.

All Trains of Saturday run directly Through to New York.

☞ **Ask for Tickets via Erie Railway,** which can be procured at 66 Clark Street, Chicago, and at all Principal Ticket offices in the West and Southwest.

L. D. RUCKER, General Superintendent, New York.

A. J. DAY, Western Passenger Agent, Chicago.

WM. R. BARR, General Passenger Agent New York.

PITTS., CINCINNATI & ST. LOUIS RAILWAY

IS 35 MILES THE SHORTEST ROUTE TO CINCINNATI!

18 MILES THE SHORTEST ROUTE to INDIANAPOLIS & LOUISVILLE

THE SHORTEST AND BEST ROUTE TO

Columbus, Chillicothe, Hamilton, Dayton, Wheeling, Zanesville, Parkersburg, Marietta, Evansville, Lexington, Terre Haute, Nashville,

All points in Central and Southern Ohio, and Indiana, Kentucky and Virginia.

— QUICK, DIRECT AND ONLY ALL RAIL ROUTE TO —

New Orleans, Memphis, Mobile, Vicksburg, Charleston, Savannah,

AND ALL POINTS SOUTH.

Trains leave Pittsburgh, Cincinnati & St. Louis Railway Depot, corner of Canal and Kinzie streets Chicago, on the arrival of trains from the North and West, as follows:

	Express. Ex. Sunday	Express. Ex. Sat'day			
Leave—Chicago	7.20 A. M.	7.55 P. M.	Leave—Chicago	8.40 A. M.	7.25 P. M.
Arrive—Logansport	12.50 P. M.	1.05 A. M.	Arrive—La Crosse	11.45 "	10.25 "
" Kokomo	2.39 "	2.18 "	" Lafayette	2.00 P. M	12.45 A. M.
" Richmond	6.30 "	6.00 "	" Indianapolis	4.50 "	3.20 "
" Cincinnati	9.45 "	9.00 "	" Cincinnati	10.10 "	9.10 "
" Bradford Junction	11.50 "	6.05 "	" Louisville	9.15 "	8.00 "
" Columbus	3.30 A. M.	9.35 "			

PULLMAN'S PALACE SLEEPING CARS

Accompany all Night Trains between Chicago and Cincinnati or Indianapolis.

Close connections made via Columbus and Pittsburgh with the

PENNSYLVANIA CENTRAL ROUTE EAST.

☞ SHORTEST AND QUICKEST ROUTE, VIA COLUMBUS, TO ☜

Pittsburgh, Baltimore, Philadelphia, and New York!

On and after Sunday, JUNE 4th, 1871, Trains for the East will run as follows:

☞ Trains leave Pittsburgh, Cincinnati & St. Louis Railway Depot, corner of Canal and Kinzie Streets.

	Cincinnati Express, No. 5.	Cin. & Col. Express, No. 1.	Col. & East. Express, No. 7
Leave—CHICAGO	7.20 A. M.	7.25 P. M.	12.40 P. M.
Arrive—LOGANSPORT	12.50 P. M.	12.50 A. M.	6.25 "
" RICHMOND	6.30 "	1.15 "	.....
" CINCINNATI	9.45 "	9.00 "	.....
" COLUMBUS	.....	9.35 "	3.30 A. M.
" PITTSBURGH	.....	5.30 P. M.	12.00 M.
Leave—PITTSBURGH	.....	6.15 "	1.00 P. M.
Arrive—HARRISBURG	.....	3.45 A. M.	10.35 "
" PHILADELPHIA	.....	7.30 "	3.00 A. M.
" NEW YORK, VIA MANTUA JUNCTION	.....	11.30 "	6.41 "
" BALTIMORE	.....	7.25 "	.....
" WASHINGTON	.....	10.00 "	.....
" BOSTON	.....	9.05 P. M.	5.05 P. M.

Palace Day and Sleeping Cars

Run Through to COLUMBUS, and from Columbus to NEW YORK, WITHOUT CHANGE!

Only ONE CHANGE to New York, Philadelphia or Baltimore!

CINCINNATI AND LOUISVILLE AIR LINE SOUTH.

☞ Ask for Tickets **via COLUMBUS** for the East, and **via "The AIR LINE"** for Cincinnati, Indianapolis, Louisville and points South. Tickets for sale and Sleeping Car Berths secured at **95 RANDOLPH STREET, CHICAGO,** and at Principal Ticket Offices in the West and Northwest.

F. R. MYERS, Gen. Pass. & Ticket Agt., **Pittsburgh.**

J. N. McCULLOUGH, General Manager, **Pittsburgh.**

W. C. CLELAND, Asst. Gen. Pass. Agent, **Chicago.**

KANSAS CITY TO SOUTHWESTERN KANSAS.

THE SHORTEST ROUTE

IS VIA THE

Leavenworth, Lawrence & Galveston

RAILROAD LINE.

Two Distinct Lines of Railway from Kansas City, Mo. & Lawrence, Kan.

UNITING AT **OTTAWA,** AND FROM THENCE A **TRUNK LINE** TO

INDIAN TERRITORY!

Passing Through the Finest Towns and Traversing the Richest Portion of this Splendid State.

TWO DAILY PASSENGER TRAINS EACH WAY!

Making Close Connection at Kansas City with all Roads East,

And at **THAYER,** (Southern Terminus), with

SOUTHWEST STAGE CO.'S OVERLAND COACHES,

For WICHITA, SANTA FE and TEXAS.

50,000 Acres Choice Farming Lands!

FOR SALE UPON THE MOST REASONABLE TERMS.

This road also Passes through the Best Portion of

THE CELEBRATED OSAGE RESERVATION,

NOW OPEN FOR SETTLEMENT.

Ask for Tickets via LEAVENWORTH, LAWRENCE & GALVESTON R. R., and Save TIME and MONEY!

CHAS. B. PECK, GEN. FREIGHT & TICKET AGENT.

O. CHANUTE, SUPERINTENDENT

LAKE SHORE
—AND—
Michigan Southern Railway.

THE GREAT THROUGH LINE BETWEEN

CHICAGO, BUFFALO & NEW YORK!

WITHOUT CHANGE.

AND THE ONLY RAILWAY

Running Palace Coaches Through!

— BETWEEN —

CHICAGO AND NEW YORK, VIA BUFFALO,

WITHOUT TRANSFER OF PASSENGERS.

☞ *All Trains Stop at Twenty-Second Street to Take and Leave Passengers. Baggage Checked at that Station for all Points East.*

3 EXPRESS TRAINS DAILY, [Sundays Excepted,] Leave Chicago from the New Depot, on Van Buren St., at the head of LaSalle St., as follows:

9:00 A. M. SPECIAL NEW YORK EXPRESS, VIA OLD ROAD. SUNDAYS EXCEPTED.

LEAVES—Twenty-Second Street 9:15, A. M. ARRIVES—Elkhart, 12:50 P. M.; Cleveland 10:05 P. M.; Buffalo, 4:10 A. M.: New York, 6:30 P. M.; Boston, 11:20 P. M.

This Train has PALACE SLEEPING COACH Attached, Running

THROUGH TO ROCHESTER WITHOUT CHANGE!

IN DIRECT CONNECTION WITH

Wagner's Celebrated Drawing-Room Coaches on New York Central.

5:15 P. M. ATLANTIC EXPRESS, (Daily), VIA AIR LINE.

LEAVES—Twenty-Second Street 5:30 P. M. ARRIVES—Laporte, 8:00 P. M. (Stops 20 minutes for Supper); arrives at Toledo 2:50 A. M.; Cleveland, 7:25 A. M (20 minutes for Breakfast); arrives at Buffalo, 2:00 P. M.; Rochester, 5:20 P. M. (20 minutes for Supper); connects with SLEEPING COACH **Running Through from Rochester to Boston WITHOUT CHANGE, making but one change between Chicago and Boston!**

NEW AND ELEGANT SLEEPING COACH Attached to this Train, Running THROUGH from CHICAGO TO NEW YORK WITHOUT CHANGE! Arrives at NEW YORK, 6:40 A. M.

9:00 P. M. NIGHT EXPRESS, [Except Sat. and Sun.] VIA OLD ROAD.

LEAVES—Twenty-Second Street, 9:15 P. M. ARRIVES—Toledo, 6:30 A. M. (20 minutes for Breakfast); arrives at Cleveland, 10:55 A. M.; Buffalo, 5:30 P. M.; New York, 11:00 A. M.; Boston, 8:30 P. M.

KALAMAZOO DIVISION.

Leave Chicago 9:00 A. M. Arrive at Kalamazoo 4:50 P. M.; Grand Rapids, 7:40 P. M.

Leave Chicago 9:00 P. M. Arrive at Kalamazoo 8:15 A. M.; Grand Rapids, 11:10 A. M.

☞ There being no heavy grades to overcome, or mountains to cross, the road bed and track being the smoothest and most serfect of any railway in the United States, this company run their trains at a high rate of speed with perfect safety.

☞ Travelers who wish to SAVE TIME and make SURE CONNECTIONS, purchase Tickets via

LAKE SHORE AND MICHIGAN SOUTHERN R'Y.

THE ONLY LINE RUNNING THROUGH BETWEEN CHICAGO AND BUFFALO, WITHOUT TRANSFER, and in Direct Connection with NEW YORK CENTRAL RAILROAD and ERIE RAILWAY.

GENERAL TICKET OFFICES FOR CHICAGO: No. 56 Clark St. and 39 Dearborn St.

CHAS. F. HATCH, General Superintendent, CLEVELAND, OHIO.

F. E. MORSE, General Western Passenger Agent, CHICAGO.

MICHIGAN CENTRAL
—AND—
Great Western Railways.

THE FAVORITE ROUTE, VIA NIAGARA FALLS,

IN CONNECTION WITH THE NEW YORK CENTRAL AND ERIE RAILWAYS,

— TO —

NEW YORK, BOSTON,

AND ALL EASTERN POINTS.

Pullman's Drawing-Room Cars!

☞ FROM CHICAGO TO NEW YORK, WITHOUT CHANGE. ☜

THE ONLY LINE RUNNING

The Celebrated Hotel Cars from Chicago to Rochester.

Passenger Trains leave Chicago from Depot, foot of Lake Street, as follows: (All Train Stop at Twenty-Second Street Station to receive and leave Passengers.)

6:00 A. M. MAIL TRAIN, [Sundays Excepted.] Goes via both MAIN and AIR LINES. Connects at New Buffalo for ST. JOSEPH and all points on Chicago and Michigan Lake Shore Railroad. JACKSON for LANSING, SAGINAW, BAY CITY, and for JONESVILLE, READING, ANGOLA and FORT WAYNE.

9:00 A. M. NEW YORK EXPRESS. (SUNDAYS EXCEPTED.) Arrives at Michigan City at 11:10 A.M.; Niles' 12:20 P. M. [Dinner]; Kalamazoo, 2:10 P. M.; Marshall, 3:24 P. M.; Jackson, 4:30 P. M.; Detroit, 6:45 P. M. [Supper]; London, 11:25 A. M.; Hamilton, 2:35 A. M.; Niagara Falls, 4:00 A. M.; Buffalo, 6:10 A. M. Rochester, 7:10 A. M. [Breakfast]; Albany, 2:00 P. M.; NEW YORK, **6:30 P. M.**; Springfield, 7:40 P. M.; BOSTON, **11:20 P. M.**

An Elegant Pullman Drawing-Room Sleeping Car!

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Going Through to BUFFALO and ROCHESTER, Without Change!

☞ This train connects at SUSPENSION BRIDGE direct with **Erie Railway.** Arrives at Buffalo 6:00 A. M.; Hornellsville, 9:35 A. M.; Corning, 10:55 A. M.; Elmira, 11:25 A. M.; Owego, 12:30 P. M.; Binghampton, 1:20 P. M.; Great Bend, 1:45 P. M.; NEW YORK, **8:30 P. M. Drawing-Room Cars are attached to this Train from Suspension Bridge to New York.**

4:10 P. M. KALAMAZOO, ST. JOSEPH & THREE RIVERS AC. (SUNDAYS EXCEPTED.) Arrives at New Buffalo at 6:55 P. M.; St. Joseph, 8:40 P. M.; Kalamazoo, 10:05 P. M.; Three Rivers, 10:00 P. M.

5:15 P. M. ATLANTIC EXPRESS. LEAVES DAILY. Arrives at Michigan City at 7:22 P. M.; Niles, 8:30 P. M. [Supper]; Kalamazoo, 10:30 P. M.; Jackson, 1:05 A. M.; Detroit, 3:45 A. M.; London, 8:35 A. M. [Breakfast]; Hamilton, 11:40 A. M.; Niagara Falls, 1:30 P. M.; Buffalo, 3:00 P. M.; Rochester, 5:10 P. M.; Albany, 1:30 A. M.; NEW YORK, 6:40 A. M.; Springfield, 6:40 A. M.; BOSTON 11:00 A. M.

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☞ **This Train connects at Toronto at 2:00 P. M. with Royal Mail Line of Steamers for all Lake Ontario and River St. Lawrence points.**

9:00 P. M. NIGHT EXPRESS. Saturdays and Sundays Ex. ☞ Arrives at Michigan City at 11:03 P. M.; Niles, 12:25 A. M.; Kalamazoo, 2:10; Marshall, 3:12; Jackson, 4:25; Grand Trunk Junction, 7:00; Detroit, 7:45; London, 1:45 P. M.; Hamilton, 4:35; Toronto, 9:35; Niagara Falls, 5:40; Buffalo, 7:15 P. M.; Rochester, 9:10; Syracuse, 12:25 A. M.; Rome, 1:55; Utica, 2:25; Albany, 6:30 A. M.; NEW YORK, **11:00 A. M.**; BOSTON, **3:30 P. M.**

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OF THE

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EDITED BY

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RAILROAD GAZETTE

SATURDAY, AUGUST 5, 1871.

Contributions.

AN AMERICAN ENGINEER IN ENGLAND.

English Passenger Service—Management of Passengers and their Baggage at Stations.

Several of the circumstances attending the departure or arrival of a passenger in any one of the principal stations here are quite noticeable to an American, and many of these peculiarities might with great advantage be adopted upon our own lines. Some of them, however, could not be, so long as rates of wages range so high in the United States, for the chief or most noticeable differences grow out of the employment of so large a number of porters at the stations on many of the lines.

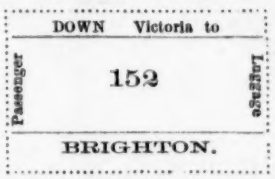
Supposing, by way of explanation, that you are going to the station in a cab; you will be driven to the edge of the walk close in front of the station, and, in some instances, perhaps, quite into the interior of the building. At once a porter is at hand, nearly always soon enough to open the cab door (the driver almost invariably remains in his seat, particularly on the two-wheeled hansom cab), and he will inquire where you are going, giving you the exact time of the departure of the train, and generally by what class of carriage. He will get your luggage out from the inside of the cab (it is always *luggage* here) and your trunk (or, as it is more commonly called, your portmanteau) from the top, and, should there be more than he can shoulder, he will get a hand-truck to pile it on. These trucks, it may be remarked, are usually only two-wheeled, though some are found with three wheels, but the latter are much larger and not so well adapted to handling small lots of luggage. The two-wheeled trucks, then, have wheels eight or ten inches in diameter, and these often have rubber tires somewhat loosely slipped into grooves in the rims of the wheels, so that they run very quietly. These trucks also have long noses or iron fronts fastened to them, so that a considerable number of boxes or parcels can be piled on at once with safety. Generally there are porters enough at the entrance of the station to enable you to get your luggage attended to at once, and in some cases the porters wait in regular turn, like the waiters in many hotel offices.

If you have any choice that part or all your luggage should go in the carriage with you, the porter upon being so instructed will attend to it, and under the seats in the compartments is always room for a good deal of stuff to be placed. One of the reasons, no doubt, why the very convenient foot-rest so universal in the cars in the United States has absolutely no counterpart here is, that this space under the seats must be kept clear for the storage of small packages or bags, and this is unquestionably a partial following out of the old stage-coach custom of thus tucking things away snugly for the journey. It is fair to say, in this connection, that no such trouble is found here in using this space under the seats for baggage as would be found in a similar arrangement in the United States, from the vastly more common practice there of using tobacco at all times and in nearly all places Your porter will be very sure to inquire also whether you want a smoking compartment or not, either when he first takes charge of your baggage or as soon afterward as may be. He will then wheel it off to the rack where the paper labels are kept, and leave you to pay your cabman and buy your ticket.

In buying tickets here, or in making other purchases, the sensation of handling only coin was at first quite peculiar, and the impression forced itself upon me that many of our present ticket-sellers would have, some day, quite a new vocation to learn, viz: that of counting rapidly the coin which must be handled in such large quantities at principal stations. Of course a very few days would suffice to acquire the needed skill, but the mechanical movements seem to be of quite their own kind.

The method of marking or labeling baggage is quite uniform over the whole railway system. It is very simple, and as it has plainly been preserved from any abuse, less can really be said against it than at first thought would seem possible.

The paper labels are quite similar to those in use in the United States, and generally have printed upon them only the name of the station to which the article may be going, and the initials of the railway company. In very nearly all cases, however, the passenger has no means whatever of identifying his own pieces on arriving at his destination, except his own assurances to the porters in attendence that this or that piece is his, and if, by any means, he is detained on the way, and his baggage goes on through, any one with sufficient assurance can claim it and carry it off. It is perfectly true, however, and this is the strange part of the whole arrangement, that the traveling public as a whole are so honest, and the railway people so skillful, that errors or thefts of this sort are very rarely committed, and your luggage is here quite as safe as need be, with only its printed label. In a few instances a label having upon it a number is pasted upon your baggage, and a similar paper label is handed to you, bearing the same number, and by this means you can identify your things on arrival. For instance, in going recently from Victoria Station, in London, to Brighton, my two pieces of luggage had labels like this pasted



upon them, and one of the same labels, with the same number was given to me. If there had been ten pieces of mine, all would have been the same number, and a single label only would have been given to me. The next person's luggage would have been 153, and so on, the highest number upon the series of labels being greater than the number of passengers likely to require numbered labels by any one train, and care is taken to use the labels in the order of their numbers.

The word DOWN on this label refers to the direction from London, as all trains are said to go "down" when they go *from* London, whatever may be their destination.

On one, or perhaps two lines, only, are the brass checks used that are so universal in the United States. The paper labels are sometimes made without gum upon them, and are pasted on with a brush; but in other instances they are attached as a postage-stamp usually is to a letter.

The porter wheels the baggage off to the "van," as the baggage car is called, and puts it in. Sometimes the guard's compartment is in the same vehicle, and he has a sort of general oversight of the baggage and parcels; but if you go from some principal point for a long journey to some other principal point, you generally find a through carriage having a luggage compartment in the center, and into this all the through baggage is put at once.

In a few cases it is still the custom to pile luggage upon the tops of the carriages (old stage coach fashion), but that is fast disappearing; for with the annoyance of dust and cinders from the engine, the danger from fire and rain, and the difficulty of getting the heavier pieces of luggage up on the roofs, it can hardly be found to pay. On very many carriage roofs the low iron railing and the big tarpaulin covering still remain, but find their occupation quite gone; for it is in hardly one carriage in twenty that they are used, and then perhaps when a carriage is unexpectedly required to run through on a long journey, and it is especially desirable to avoid transfer of luggage, or when an unusual number of pieces must be carried by some particular train. It would seem, too, hardly practicable to tuck in and lash down the tarpaulin so securely as to prevent the chance of injury from fire or water. It is fair to say, however, that choice is always made, when luggage is piled on the carriage tops, of such pieces as could be least injured by any exposure, such as wooden chests or the iron trunks or portmanteaus that are much used here.

Your porter will be on the lookout for you after you have got your ticket and are ready to get into the train. At some terminal stations there are barriers erected at the end of the departure platform through which all passengers must pass to the train, and where all tickets must be shown, and at a similar barrier at the end of the arrival platform the tickets of the incoming passengers are taken. These barriers, however, are by no means so commonly used as I had supposed, and appear chiefly to be employed in connection with the short-line trains, which carry large numbers of passengers, and must be quickly got out of the way of following trains that arrive at the same platform. Most of the passengers arriving by these short-line trains, go at once on foot to their places of business, and hence there is little need that their train should be drawn in to the platform where cabs are waiting, as is so desirable for trains coming from greater distances, and where no barriers are placed.

The porter will show you the compartment where your smaller parcels are stowed, and, if it be winter time, will see that you have one of the ridiculous (fairly so) foot-warmers they use here; and then, having done all he can for you, he will at least *hope* for some small fee, although on all lines the servants are strictly forbidden to receive any gratuities. For this ordinary service few passengers ever pay any fee at all, but sometimes there is some special or additional thing that a porter will very willingly do, and for which a six-pence may very well be spared. If you have been staying in London, you will now speedily dispense with your silk hat, and, if it be winter time, wrap at least your knees as closely in your rug or lap robe as they can be, for a water bottle is hardly effective in warming more than the soles of your feet.

A few minutes before the train starts the ticket inspector comes along and examines each passenger's ticket, to see that each is in the right compartment and that all have taken the right train. Sometimes the tickets are merely looked at, and sometimes a nip is taken out of the edge, and by the same punch a number—that of the inspector, no doubt—is stamped on the ticket. For this purpose the punch making a hole inside of the edge is very rarely used. The inspector generally closes the door after him, and on long runs it is sometimes locked; but this custom does not appear to be very closely adhered to anywhere. Often a porter may now be heard shouting "any more for A, B, C," etc., or whatever the stations may be, or he will come to the doors of each carriage inquiring "all here for D, E, F," etc. Then the guard blows a little trill whistle which he carries at the end of a chain fastened to his coat, and makes sometimes a gesture to the driver, and sometimes he waves a little green flag. At once the driver blows the engine-whistle a single, short blast; or if he must look, as generally he must, for an outside or yard signal, he will blow one, two or three longer blasts to call for the signal, according to the characteristic number of his train.

Very promptly, however, the train gets away when the guard has given the signal, and sometimes a high speed is immediately acquired, although in the yards of many principal stations there are switches or rather signals that must be watched for, and waited for, if necessary. Usually, where the traffic that must be provided for will admit of it, the tracks (or, as they are called here, the lines) are so laid that the passenger trains can approach and leave the station without the chance of any interference of goods trains or of "shunting" engines.

The usual coupling of carriages, the fixing of signal lamps, and the connection of the alarm lines which are now required on many trains, all have some points of interest, but special mention of them may be made at another time.

It is almost invariably the custom here to collect the tickets just before reaching a terminal station, the train being stopped for the purpose, usually at a narrow platform 400 or 500 feet long, erected within a few hundred feet of the station and high enough to allow the ticket collector easy access to the carriage doors. In some instances tickets are called for at the last station where the train stops before reaching the terminus, and this station will be found at a distance of from 2 to 15 miles or more, as may happen, and in one instance that I remember, the ticket had been purchased at one of these stations, and was taken away again before an inch of the journey which it represented had been traveled. When the train has stopped at one of these places where tickets are to be collected, one or two of the guards (or, as we call them, the brakemen) walk along the side of the train, calling out, "All tickets ready, please," and unlocking the carriage doors, if necessary, so that the ticket collectors (generally two for a long train) may be as little delayed as possible. These collectors generally attend only to taking the tickets from the trains as they arrive, and to sorting them for transmission to the Railway Clearing-House, one of the important institutions of the English railway system.

I think it will be seen quite readily that there is no other convenient means of collecting tickets when, as upon the English lines, the passengers are inaccessible except when the train is stopped. On some lines, where stops are made at intervals of eight or ten miles, the tickets are collected at one station from passengers who are to leave the train at the next, and this frequent examination of tickets is often quite annoying. At smaller stations, and with the train making many stops, the custom is for the station agent or a porter to collect the

tickets at a gate through which passengers leave the station premises.

It is frequently the case that upon nearing a station a train must wait for its own signal before it can enter, and sometimes, although rarely, quite an elaborate series of whistlings is gone through with. If the station be a terminus, when the train is fairly within it and by the side of the platform there will sometimes be found a kind of rivalry among the porters, always in waiting for the trains, for the chance of securing your cab or of attending to your luggage. They will frequently run along by the side of the train just before it stops, and will hang on to the side steps to receive, if need be, any instructions from the passengers. It will thus be seen that if any one requires the services of a porter it is a very simple thing to watch from the window, as the train enters the station, and to secure the first one whose attention you may be able to attract. His first question will be whether you want a cab, and whether a two-wheeler or a four-wheeler (the Hansom cabs have two wheels only, and are not well able to carry large trunks). If you say yes, he will whistle or make some other sign to the nearest cab-driver, who is waiting on his box, and is generally, as I have before explained, in the line of cabs just across the 20-feet platform, and the train having stopped he will take your parcels, hat-box, etc., out of the compartment in which you have traveled, and will put them into the cab, thus securing it for your use. It is necessary to go then to the luggage van, or to the compartment where your heavier luggage may be, and to point out your own to the porter, either by means of the numbered label before described, or by such other means as you can use to best advantage. Sometimes a general movement among the porters is made to get all the luggage out of the van before any attempt is made at selecting pieces for any one, but oftener it is every one for himself, and let the best man win. It is never the case, so far as my own observation goes, that there is provision made, here, such as is common or quite universal in the United States, for the convenient placing of baggage when removed from the train for selection by the passengers; but it is dropped close alongside of the van—anything, apparently, so as to get this piece out of the way and get hold of the next one. As might be expected, it sometimes occurs that a needless confusion arises, and the total delay is too great, although the first man may get his luggage away very quickly, if it happens to be on top of the pile in the van. If the cabs are standing at a distance from the van, the porter usually brings up one of the two-wheeled trucks already mentioned and carries your luggage to any cab you may select.

If, for any reason, you desire to leave your luggage at the station for a day or two, or for a longer time, the so-called "cloak room" is provided in every station of importance throughout the kingdom, where it may be placed in charge of the station officials, who, for a prescribed payment, give a receipt for the articles, whatever they may be. This arrangement for the convenience of the traveling public is worthy of the strongest commendation, and cannot be adopted too soon by American companies in all parts of the country. All articles that may be left by accident in the trains are put in charge of the same persons, and are retained to await inquiries from their owners. The precise regulations and charges required for this service I cannot give at this moment, but will shortly.

Laying Out Railroad Curves.

Columbia, Pa., July 21, 1871.

To the Editor of the Railroad Gazette:

In your paper of June 24, page 146, I find a solution of the proposition to run a tangent from a railroad curve to pass through a visible but unknown point. This solution is ingenious and strictly true, but, like many of its class, involves an amount of calculation not very convenient or rapid enough for field operations.

The following solution is not liable to this objection: Let

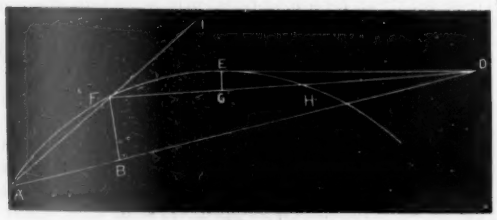


Fig. 1.

$A\ F\ E$ be the curve (Fig. 1) and D the unknown point; required to find the point, E, of a tangent to pass through D. Choose A and F, two stations as near the end of the curve as possible, and measure the angles $F\ A\ D$ and $I\ T\ D$. The difference of these angles will give $A\ D\ F$. Then $A\ F : F\ D$ as co-secant $F\ A\ D$: co-secant $A\ D\ F$, and if the two angles be conveniently small the proportions may be taken directly as the angles without sensible error. The deflection of $F\ D$ from a tangent at F will give the length of $F\ H$, and by a well known proposition in plane geometry $F\ D \times H\ D = E\ D^2$. Make $D\ G = E\ D$, and find the curvature of $G\ E = \frac{5,730}{G\ D^2}$, and E may be found by the intersection of the curves. But if A and F have been properly chosen, *i. e.*, if $F\ H$ does not greatly exceed 100 feet, $G\ E$ will not differ sensibly in length or direction from an ordinate to the curve at G.

In my treatise on railroad curves, published in 1852, will be found a method of calculating these ordinates, as follows:

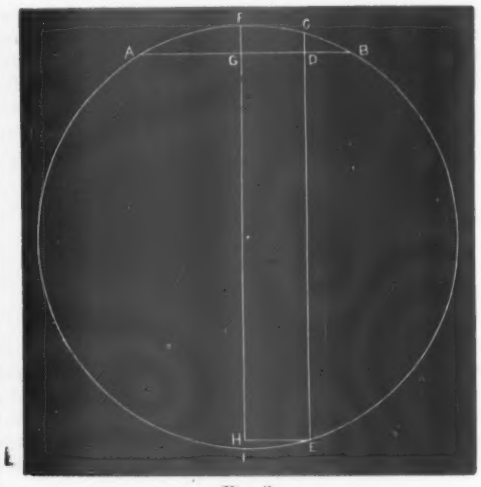


Fig. 2.

Let $A\ B$ (Fig. 2) be the chord and $C\ D$ the ordinate; then $A\ D \times D\ B = C\ D \times D\ E$, but $D\ E =$ the diameter, $F\ I$,—$(F\ G + H\ I)$. Take $A\ D = a$, $D\ B = b$, $F\ G + H\ I = X$ and let the curvature be represented by m, and the equation then becomes $C\ D = \frac{a\ b}{D - X}$. In all cases of location, however, X is too small a quantity to affect the result injuriously. It may, therefore, be omitted, and the equation becomes $C\ D = \frac{a\ b}{D}$. But $D = \frac{11,460}{m}$; hence $C\ D = \frac{a\ b\ m}{11,460}$. But now if we take the primary chord of 100 feet as a unit, and consider any number of feet below that number as a decimal fraction of that unit, then the value of $C\ D$ in feet becomes $\frac{a\ b\ m \times 10,000}{11,460} = a\ b\ m \times .875$, *i. e., multiply the product of the two abscissas (considered as decimal fractions) by the curvature, and from this result subtract one-eighth*, for the value of $C\ D$ in feet. This will be found sufficiently correct for all practical purposes, the error even in the extreme case of a chord of 200 feet and a curvature of 10° being only 4-100 of a foot in a middle ordinate of 8.79 feet, the above equation giving 8 75.

S. W. M.

TRACTION ENGINES.

To the Editor of the Railroad Gazette:

Mr. W. C. Oastler, of No. 43 Exchange place, New York, agent of Aveling & Porter, of Rochester, England, has just imported a 6-horse traction engine, of a new pattern, designed for farmers. Instead of the chain gearing used in the heavy engines and road rollers of this firm, spur gearing is used to transmit the power to the driving wheels. This gearing is cheaper, and seems easier to keep clean and well lubricated; and I judge that it will prove more economical and convenient than the chain. It has an important improvement over their earlier engines, in a differential gearing, which causes the drivers to travel at unequal speeds, just as required, in turning curves. The motion is transmitted by a pinion on the crank-shaft to a spur-wheel on an intermediate shaft, thence by a pinion on the intermediate shaft to a spur-wheel which runs loose on the driving axle and carries bevel pinions which gear into bevel wheels, one of which is fixed on the drawing axle and the other on the right driving wheel, which turns on the axle when going on a curve, the left driver being keyed upon the axle. This device is old, but it is novel in its design and details. The effect of it is to utilize the motive force of both wheels at all times. In former engines, when turning, it has been necessary to unclutch one wheel, thus for the time losing one-half of the adhesion, and often causing the wheel to slip. The pinion on the crank-shaft can be slid out of gear; the engine then can work as a portable engine of the common kind to drive any sort of agricultural machinery.

The cylinder, single, is 7¾ inches bore and 10 inches stroke; the driving wheels are 5 feet diameter, and 10 inches width of tire; and the gearing gives one turn of the wheel for 17 turns of the engine. The total weight is 11,700 pounds, and the price, in New York, $3,000, gold.

The driving wheels are wrought iron, except the hubs, which are cast; and the steering wheels are of wood, except the hub and tires. It has been usual to make all the wheels of cast iron. Undoubtedly these wheels are lighter and better, but more costly.

The performance of this engine is quite satisfactory. One man works it. I saw it going without a train behind it. It went up a hill which I judged to be as steep as 1 in 6, with 74 pounds pressure—115 pounds being the pressure allowed, and 140 pounds being within the limits of safety and available if spuds be put into the wheels to prevent slipping. It was therefore evident that the engine would draw its own weight behind it over almost any kind of road.

A trial of an engine of this pattern was made at an agricultural show at Barnhurst, England, on the 3d of this month, in which it drew a gross load of 12,320 pounds over a field drenched with rain. The *Engineer* says: "The great contest between iron and rubber tires "came off this afternoon, and resulted in the complete "discomfiture of the latter. It is but fair to remark "that the ground was in a greasy condition, which is "the least suited for india-rubber-tires, and that the "steady down-pour of yesterday, added to to-day's "drenching rain, has reduced the course in many "places to the consistency of hasty pudding." The Aveling engine, using spuds to dig into the ground, drew its load to the end, while the rubber-tired engine could not get through the miry places.

The rubber-tired engines, on roads, and under fair conditions, worked admirably; but under extreme disadvantages they were decidedly beaten by the iron tires with spuds. The spuds can be put in or taken out in 5½ minutes, when required to get out of a difficulty; but their use on a road would not be allowable, nor at all necessary or desirable to the carrier.

I do not hesitate to say that this engine is equal to any portable engine I have seen, for stationary work. It has 100 feet of heating surface, which makes steam enough for 150 turns a minute. The construction is excellent, and sufficiently stout for durability, while it is light enough for good service on the road or field; and I do not doubt the claim of the agent, Mr. Oastler, that it will work at a third of the cost of horses, on the road or in haulage on the farm. And I believe that it can do nearly all of the work of draft horses, so that they need not be kept. And it is obvious that the expense and trouble of keeping it through the winter must be slight compared with horse-keeping.

The engine can be seen at work on application to Mr. Oastler; and all who have use for such a machine should examine it. The time has come for the locomotive to extend the circle of its usefulness. It works on railways at less than a sixth of the cost of its work in 1833; and after a few years of practice it will probably work much cheaper than horses for most work that is now done by horses.

J. K. Fisher,
No. 30 Broadway, New York.

Resistance of Curves to the Passage of Trains.

To the Editor of the Railroad Gazette:

The resistance experienced by a car in passing around a curve may be regarded as being made up of three parts:

First: slipping of the wheels.

Second: rolling friction.

Third: friction caused by the rubbing of the flange against the rail.

The slip of the wheels is due to the difference in length of the outside and inside rails. That is, the outer wheel must run over a greater distance, when passing a curve, than the inner one; and as each pair of wheels is rigidly fixed on the same axle, and both must make the same number of revolutions, one of the wheels must slip on the rail—either the outer one forward or the inner one backward.

Let us determine the amount of slip. For example, suppose we have a curve of 300 feet radius to the inside rail, a gauge of 4 feet 8 inches, 3.1416 the ratio of the diameter to the circumference; then when the angle subtended by the curve is 90 degrees, or a quarter circle, the length of the inner rail will be: ¼ of 300×3.1416, or 235.62 feet. In the same way, the length of the outside rail will be ¼ of $304\frac{2}{3} \times 3.1416$ or 239.28, and the difference between them 3.66, or 3 feet 8 inches, which is equal to ¼ of $4\frac{2}{3} \times 3.1416$. In other words, the difference in length between the inner and outer rails is equal to the fraction of the circle which the curve forms multiplied into the gauge—and that into the ratio of the diameter to the circumference.

It will be noticed that this last calculation is quite independent of the radius of the curve; and hence it follows, with the same subtending angle, the slip is the

same both for sharp and easy curves. It is also to be noticed that this quantity varies with the gauge.

The rolling friction on a curve may be regarded as being the same as upon a straight line; or, say, about 6 per cent. of the weight of the train.

The path of motion of any point of the flange which comes in contact with the rail is a cycloid; and hence, when rubbing against the rail, the point moves in an approximately vertical line, so that any point comes down, engages with the rail, and rises again; and the same is true of all successive points—the friction between the points and the rail being continuous. This is illustrated by the action of cart-wheels, where, in the city, they at times run against the outer vertical face of the curb-stone. Here, especially at the lower part of the face, vertical scratches may be seen, made by the tires of passing wheels.

When the truck strikes the curve its tendency is to roll forward in a straight line, and the flange of the outer forward wheel comes against the rail at an angle. This angle increases with the distance between the axles, and with the sharpness of the curve. When the wheel and rail are parallel, as upon a straight track, the flange strikes the rail near its top surface but, when the wheel comes at an angle, the rail will strike the surface of the flange at a larger diameter; and hence at a certain distance forward of the foot of a perpendicular let fall from the axis of the wheel. The greater the angle of the wheel with the rail, the greater will be the distance just named. That is, this distance increases with the sharpness of the curve and the distance between the axles. It is the short arm of a lever, which, multiplied by the friction of the point of contact and divided by the radius of the wheel, will give the resistance due to this cause.

From the above analysis we deduce the following practical conclusion:

The nearer the point of contact comes to the top surface of the rail the more nearly is the friction a rolling resistance, and the less the length of the short arm of the lever spoken of above; and hence the less the resistance to the passage of the train around the curve.

The form of rail and flange must be such as to fulfill the above named conditions, while, at the same time, the surface of contact must be large enough to resist the force with which the flange is urged against the rail. This result is to be obtained by making the top of the rail a curve of large radius, and by having the radius of the rounded corner of the rail notably less than that of the corresponding flange. A.

[Our correspondent seems to assume that the outer wheels on curves must slip over a distance equal to the difference in length of the outer and inner rails, which cannot be entirely true, as car wheels are almost universally *coned* so that the centrifugal force causes the outer wheels on curves to run on a considerable larger diameter than the inner ones, thus obviating the necessity of a portion, if not all, of the slipping.

Again, is it correct to regard the rolling friction on a curve as being the same as on a straight line? Theoretically, the wheels may be so coned and the outer rail of a curve so elevated that, for an assumed speed, there will be no slipping of wheels and no friction of flanges against the rail. There will, nevertheless, be a considerably increased resistance, due to added "rolling friction." This increase of rolling friction is owing to the fact that the train *presses harder* directly upon the track on a curve than on a straight line. The outer rail is so elevated—or intended to be—that gravity, tending to force the car down the incline across the track, counterbalances the centrifugal force. Thus the centrifugal force is resolved into two components: one vertical, met by the force of gravity; and the other perpendicular to the surface of the track, and met by the *reaction of the track*. It is this last added pressure which materially increases the rolling friction on curves—ED. RAILROAD GAZETTE.]

Locating Bridge Piers.

MAUCH CHUNK, Pa., July 23, 1871.

TO THE EDITOR OF THE RAILROAD GAZETTE:

Will any engineer employed on one of the larger Western bridges describe his method of overcoming the practical obstacles in the way of locating the piers? whether transit instruments of any specified construction are used; his method of taking soundings; in fact, anything of interest pertaining to the work.

INQUIRER.

—The Norway Iron Works, of Wheeling, with all its coal privileges, were sold on the 11th to H. W. Drakeley for $47,000. The sale was made under a mortgage executed by the Norway Company to Mr. Drakeley for balance of purchase money.

RAILROAD LAW.

***The Cawood Patent**—The long litigation ended in favor of the assignee.*

The cases of *Samuel H. Turrill vs. The Illinois Central and several other railroad corporations* have been among the most interesting and important ever tried in this country, and have recently been decided in the United States Circuit Court, in favor of Mr. Turrill, the assignee. Whether the litigation will be still further protracted we are unable to determine. The following is a brief summary of the facts and of the decision:

This case has been of itself an illustration of the difficulties under which the patentor of a useful improvement labors in obtaining the reward supposed to be secured to him by his patent. Several years ago, when railway iron was not so extensively used as at present, the rails at places, generally the ends, which are exposed to unequal pressure, having exfoliated, they were repaired by welding on a piece, a common anvil and swage block being used as the tool upon which to rest the bottom of the rail. The result was a slow, tedious and, therefore, expensive labor, rendered the more unsatisfactory because, in the act of pounding upon the surface of the rail, the neck of the rail became thickened, so that it had to undergo further swaging by hand tools to elevate the crown. A Mr. Cawood, probably a working blacksmsth, hit upon the device of placing upon the ordinary anvil a stationary block, the face of which should be fashioned to fit the surface on one side of the rail to be mended. The rail being heated to a proper degree and placed against this swage, there should then be a movable block of corresponding shape, fitted to the other side of the rail, moved up to it by the use of a cam or other device, and be there held so that the rail was held as in a vise, the neck being supported, and the crown of the rail alone exposed to the pressure of the blows while the process of welding was being conducted. Claiming this as the invention of a new and useful machine, he procured a patent, and this patent has ever since been in controversy, at a cost to the assignee of the patentee of some thirty or forty thousand dollars.

The validity of the patent has been attacked in numerous shapes, but most forcibly by the assertion that the machine was known and used prior to the invention of the patentee. The first case was tried against the Michigan Southern & Northern Indiana Railroad, commencing at Detroit a number of years since. That case went to the Supreme Court of the United States, where the patent received a construction. In course of time an action at law was tried in this city against the Illinois Central Railroad Company, beforge Judges Davis and Drummond, in which, governed by the judicial construction heretofore given to the patent, there was a verdict for the assignee of the patent, with damages. This case also went to the Supreme Court, but the appeal was not prosecuted. A bill was then filed in the interest of the patentee against several railroad companies, which, in the course of time, came on to be heard before Judge Drummond, a year or two since, and this cause he has now decided in favor of the patentee.

From the opinion of the court we take the following:

"This controversy grows out of an alleged infringement by the defendants of a patent granted to Joseph D. Cawood on the 9th of September, 1856, for an improvement in the common anvil or swage block, for the purpose of welding up and reforming the ends of railroad bars when they have become injured from unequal wear, and of which the plaintiff is the assignee. This patent has been before the Supreme Court of the United States, *Turrill vs. Railroad Company*, 1 Wallace's R., 491. It has also been before this Court, *Turrill vs. Illinois Central Railroad Company*, 3 Fisher, P. C., 330. In this last case the law and facts were submitted to the court, and the patent was held valid, though attacked by the angle iron machine, the bayonet machine, and the Church machine. The court was then of the opinion that there was nothing in these old machines to prevent the operation of the patent of Cawood as continued by the Supreme Court. It was admitted, in view of the previous machines, that the Cawood patent could not have a broad construction, but must be limited to such a movable press block as was described, or its equivalent, in combination with such other block as was described, or its equivalent, united and operated as described, and for the purpose described.

* * * * * * *

"The movable press block described is put upon and connected with various other parts of the machine. There is, first, a bed-sill of the proper size. Upon this is placed an anvil of cast iron. There is a raised solid block forming a part of the anvil, with its side shaped to the side of the rail which is to be placed in it. Then upon the face of the anvil, and next to the raised block, with its side shaped as above, is put the movable press block. It is attached to the anvil. It is worked by eccentric cams. It has its side next to the raised block, shaped also to hold the rail; the latter thus has the raised block on one side, and the press block on the other. This is the kind of press block described, and this is the kind of other block described. It operates in this way: The piece of iron is prepared and heated; the rail is also heated in the fire, and is then swung round; the movable block brought against the rail, which is thus between the two as in the jaws of a vise, and there firmly held, with the crown of the rail above and resting on the blocks, until the welding or reforming process is completed.

* * * * * * *

"The purpose effected is the reparation of the rail. Now, it is clear that no true construction of this patent can be given, without connecting the claim as made with the machine, and its purpose and mode of operation. Therefore, while it is essential that the various parts claimed should be constructed so as to accomplish the purpose, it is also essential that the parts claimed should be connected with parts not specifically mentioned in the claim; for example, with something to support the jaws of the vise as well as the blows given in the act of reparation of the rail. It is clear, therefore, the jaws as described and constructed cannot be separated from other parts mentioned in the specifications.

* * * * * * *

"It follows, therefore, that what gives support to the blocks is an essential part of the machine, and that it is not precisely correct to say that the only function of the Cawood machine is to hold the rail while being mended. That is only a part of its function.

* * * * * * *

"Cawood does not, in terms, in his claim, make the support to the jaws a part of his claim but it necessarily follows, from the two things, that he does claim in combination, *in the manner described and set forth* by him, that it is an essential part of the invention. One of the blocks is a raised part of the anvil; the other is attached to it and movable backward and forward, so as to let in and firmly clasp the rail. If we were to remove the part beneath, we should deprive the machine of one of its essential parts, and without which it would not be the machine described.

* * * * * * *

"Some question has been made whether Cawood intended the rail, in process of raparation, should rest as well upon the anvil as be clasped in the jaws of the blocks. There is nothing distinctly stated in the specifications to that effect, but there can be no doubt, I think, when fairly considering them in connection with the drawings, that such was supposed by him to be one of the incidents or results, and, perhaps, a necessary one to the successful operation of the machine.

* * * * * * *

"And yet it is clear, if the whole bottom support is removed, an essential part of the Cawood machine is gone and there is nothing left, in effect, but a common vise.

* * * * * * *

"The fact that the machine has been used, and, by some of the defendants, several years, as intended by Cawood, without special complaint, strengthens this view of the case. But even if what is added or taken away by the defendants is an improvement of the Cawood machine, it is still the machine so long as its essential characteristics remain the same.

"On the whole, then, there is nothing in this case to prevent the operation of the Cawood patent, when fairly constructed, and therefore it will be held valid. I shall refer the case to a Master, with directions to report what machines used by the defendants infringe the patent of the Cawood machine, within the rules and principles here stated; also, what damages the plaintiff has sustained by such use."

***Negligence.**—Railroad companies not liable when injured person only in fault—Duty to public as to stationary cases.*

In the recent case of *Chicago & Alton Railroad Company vs. McLaughlin* the following were the substantial facts:

It appears that the track of the road is laid down through one of the public streets of the city of Springfield, and its freight depot fronts upon the street. The track is thus accessible to the public. The plaintiff was at play with other boys upon the track, or street, and climbed upon the step or stirrup of a freight car standing there. The yard-master came and mounted the same car, going to the top by the same stirrup, at the south end of the car. As he went up the stirrup the boy let go and stood by the side of the car. The yard-master passed, on the roof of the car, to the north end and loosened the brakes. The car then began to move, from what cause does not appear, as it was an isolated car, but we suppose it was standing on a descending grade. Before the car had moved over a space equal to its length, it passed over the foot of the boy, inflicting serious injury

Upon the general principles involved the court says:

How the yard-master was guilty, in this transaction of culpable negligence, we are wholly unable to perceive. Waving all question of what degree of negligence is attributable to parents who permit their children to play about railway depots and cars, we are of opinion that this evidence discloses no omission of duty, or any wrongful act on the part of the railway employe.

We hold there was no duty to give warning, unless he knew or had reason to believe that the boy was in a position where he would be placed in peril by the movement of the car.

Judgment reversed.

***Common Carriers.**—Railroad companies are liable for the mistake of an agent.*

In the recent case of *Meyer vs. The Chicago & Northwestern Railway Co.* (24 Wis., 566), the facts were these: Goods were shipped to "J. Weil & Bros." The goods were plainly and legibly marked, so that there could be no mistake about the consignees; and it was the obvious duty of the agent to see that they were properly entered on the way-bill. This he did not do, but through carelessness he entered the goods as though consigned to "T. Weil & Company." Consequently when the employes of "J. Weil & Brothers" called for the goods at the freight depot at Chicago they were told that there were no goods there for them. And the mistake was not discovered until the goods were burned, with the freight depot, shortly after. Now, the question is, should not the company be held responsible for the mistake of its station agent at Jefferson, in thus entering the goods on the way-bill sent to Chicago, so that it failed to point out the true consignors?

The court declared that the company was so liable, and says: "It was, then, in consequence of the negligent acts of the agents of the company, whose duty it was to enter the goods properly in the way-bill, that they were destroyed; and the company, upon every principle, ought to make the loss good."

RAILROAD GAZETTE

PUBLISHED EVERY SATURDAY.

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Editorial Announcements.

Correspondence.—We cordially invite the co-operation of the Railroad Public in affording us the material for a thorough and worthy Railroad paper. Railroad news, annual reports, notices of appointments, resignations, etc., and information concerning improvements will be gratefully received. We make it our business to inform the public concerning the progress of new lines, and are always glad to receive news of them.

Articles.—We desire articles relating to railroads, and, if acceptable, will pay liberally for them. Articles concerning railroad management, engineering, rolling stock and machinery, by men practically acquainted with these subjects, are especially desired.

☞ *Our Prospectus and Business Notices will be found on the last page.*

NEW ROUTES TO THE EAST.

Although thousands of miles of railroad lines tributary to Chicago have been constructed of late years, including many new and important lines, the city's connections with the East—the number of lines between Chicago and the seaports—have not materially increased since the Fort Wayne road was opened thirteen years ago. The completion of the line formerly known as the "Great Eastern," opened a new route to Pittsburgh, but not to points further east. We have substantially three complete lines between Chicago and New York, the Michigan Central and the Great Western of Canada forming one line to Buffalo, the Lake Shore & Michigan Southern a second, the New York Central & Hudson River and the Erie forming two lines between Buffalo and New York; the Pittsburgh, Fort Wayne & Chicago Railway and the Pennsylvania Railroad forming the third line between Chicago and New York. All these lines were open in 1858, since which time the population of Chicago has tripled, the mileage of railroads depending on these lines for an outlet to New York has increased from less than ten thousand to something like twenty-five thousand miles, and the traffic between the East and the West has grown faster even than the population and the railroads. Capital has been easily obtained for new and costly lines through an uninhabited country, and yet no effort to make a new line to the East has been successful. It is not strange that surprise is expressed at this want of growth of routes where traffic has grown most. Meanwhile the old lines have been among the most profitable undertakings of the age, earning large dividends, often on fictitious capital, and, apparently, presenting all the attractions which induce capitalists to invest their money in similar enterprises.

There are reasons, however, for this apparently exceptional condition of things, some of which we will try to make known:

In the first place, while there has been no increase in the number of the railroads, there has been a very large increase in their capacity. In spite of frequent assertions to the contrary, the traffic between Chicago and New York is not only not beyond the capacity of the three existing roads, but they could readily be made to accommodate double their present traffic. It must be remembered that west of Pittsburgh and Buffalo these "great trunk lines" have only a single track, and that it is but lately that the pressure of business at the busiest seasons has been so great as to justify the investment of the capital necessary to add a second track. Whenever business has been offered in excess of the facilities offered, which has happened sometimes, the lack of capacity has been in the rolling stock, and not in the road. Within the past year the single-track lines have met with delays for lack of sufficient sidings, and it is evident that all of them must soon add a second track or else have their trains delayed and their customers disappointed for a considerable part of each season. Indeed, this work has already been commenced. The Lake Shore & Michigan Southern will have a double track as far west as Toledo, the Michigan Central to Jackson, and the Pennsylvania Railroad Company, having two distinct lines between Pittsburgh and Chicago, can do a very large business between those places without crowding.

The increase of capacity of which we have spoken has been made by additions to rolling stock and improvements of permanent way. Thus the tonnage of freight moved over the Michigan Central Railroad has increased in seven years from 542,000 to about 1,100,000 tons; on the Fort Wayne road, from 805,000 to 1,740,000 tons; and on the Lake Shore probably quite as fast, until last year it amounted to about 3,000,000 tons. Improvements in road have made it possible to haul heavier trains, and the number of cars has been increased.

The limit has not been reached yet. The addition of a second track will largely increase the capacity of the lines as far east as Buffalo and Pittsburgh, as is shown by the actual traffic done over the double-track line of the New York Central & Hudson River road, in the last year reported. On this road, with a main line 442 miles long, and 400 miles of branches, chiefly single-track; trains ran about 11,500,000 miles in one year; whereas on the Fort Wayne road, with 468 miles of main line and 32 miles of branches, the train mileage was 5,400,000 miles; and on the Lake Shore road, with 540 miles of main line and 473 miles of branches, 8,219,893 train miles were made. At the same time the Pennsylvania Railroad, with a double-track main line 355 miles long and 245 miles of single-track branches, made 10,185,233 train miles.

However, it may be very well said that the capacity of a line between New York and Chicago will be equal only to that of its most imperfect part; and if a second track should double the capacities of the lines west of Pittsburgh and Buffalo, it would not at all improve the roads east of these cities. The limit of their capacity is the limit of capacity for traffic by rail through between Chicago and New York. That limit is not yet reached, but even a double-track railroad may be blocked with trains.

The remedy for this is the addition of a third track solely for passenger traffic, by which the capacity of a line may be increased enormously. Freight trains may be run within fifteen or twenty minutes of each other, on a double-track road, day and night, if the working of the line is not complicated by the running of fast passenger trains on the same tracks. The delays occasioned by waiting for such trains, the waste and wear due to running heavy freight trains at high speed, in order to keep out of the way of passenger trains, are not easily exaggerated. With a third rail the existing lines will probably be equal to the traffic for twenty years to come or longer.

Still, as there has been little difficulty in obtaining means for constructing new competing lines in the West, where the existing lines, perhaps, were not worked up to one-fourth of their capacity, the failure to make new lines to the East may not be explained by the adequacy of existing lines. Capitalists do not often hesitate to invest in a railroad which will take traffic another road can do, if only they are convinced that the new road will get traffic enough to pay, and it seems plausible enough that money would be made by dividing the business which now pays sixteen, twenty or twenty-five thousand dollars per mile, when it is expected by dividing that which amounts to no more than ten or twelve thousand per mile. But it is a peculiarity of the lines from Chicago to the East, and has been from the first, that they must do their work in the face of the severest competition by the cheapest transportation known. The water route always has and always will limit the charges of railroads between this city and the East. The profit on through traffic is thus limited to the minimum, even when there is no competition between the different railroads, and a very large amount of through traffic is necessary to pay a moderate income.

But it would probably be easier for a new road to obtain a good share of the through business than a local traffic at all comparable with that of either of the existing lines. The country through which such a line must run is now for the most part well provided with railroads. The old lines were constructed when the country was new and the large towns have grown up at their stations. A new road would pass through scarcely one considerable village whose whole traffic it could command. If it should pass for the most part to one side of existing roads, it would have scarcely any towns of importance on its line, and towns in this comparatively old country cannot be created as they were fifteen or twenty years ago. Therefore, the new line will not only have to compete for its through traffic, as the present roads do, but for most of its local traffic. This fact, perhaps, more than anything else, has prevented the construction of new lines heretofore.

Another difficulty in the way of a new road is the extent to which the trunk lines to the East have formed alliances or closer relations with a large part of the other railroads of the country. These combinations of roads are not now generally worked as single systems, but they easily may be, and if a company should build a new railroad into Chicago from the East, and then find that all the railroads entering the city from the West were sending all their traffic by the old lines, Chicago might not seem so desirable a terminus after all.

But it is not probable that all these difficulties together will prevent much longer the construction of one, two or three new routes to the East. It is noticeable that most of the plans are not for the eastern half of the route, where the lines are most limited in number, but for the western half, where the railroads already exceed in number their outlets. There are three companies which promise to give new routes from Chicago to Buffalo or to Pittsburgh within about two years, and but one scheme at all advanced for a line further east. These new lines are in such condition and under such management as to make it probable that all of them will be completed unless there shall be some unusual financial derangements during the next year or two.

One of these, on which also a second depends, is the Canada Southern Railway of Canada, and the Canada Southern & Chicago, which latter is to connect the former with Chicago. The Canada road is entirely located and under contract. Some surveys have been made for the western section, but if anything has been decided concerning its location, farther than its termini, it has not been made public. There has been no little incredulity concerning the professions of the managers of this scheme, many having believed it to be simply an attempt to "bluff" the Canada Air Line, which the Great Western of Canada is constructing. This incredulity, probably, arose from the fact that several of the leading stockholders and managers of the Canada Southern are also large stockholders and directors in the Lake Shore & Michigan Southern, for whose through business and a large share of its local the Canada Southern must compete. The line, however, seems to have been planned with an eye single to through business, and with something like a contempt of local traffic. First of all, low grades and tangents seem to have been looked for, and, we must say, with remarkable success, the lines in Canada having no grade of more than fifteen feet to the mile; and we understand that it is expected that a line to Chicago will be found with similar grades. The great advantage that these easy grades will give is evident. Much heavier trains can be hauled than on lines with grades of forty or fifty feet to the mile, with the same power and the same expense for train service.

On the other hand, the Canada lines will pass through only one town of a thousand inhabitants and a country thinly settled and not likely to grow. Its local traffic will be further cut off by the Great Western Railway and its new Air Line, rarely more than four or five miles from it. The line through Michigan and Indiana will be through a fine and populous country, but it will be for the most part as near the Lake Shore & Michigan Southern as the Canada line is to the Great Western, and for one hundred miles or so of its western part it will be through a net-work of railroads, which will leave very little for any competitor.

The Michigan Midland will depend upon the Canada Southern and its St. Clair Branch for its connections with Buffalo, and so may be regarded as a feeder to that road rather than as an independent line. It is the only one of the new lines which has any part of its road in operation. Of the Western Division, 120 miles, from Lansing, Mich., southwest to South Bend, Ind., is in operation. When completed, it will be a line from Chicago to St. Clair, Mich., about 310 miles long, and, in connection with the Canada Southern, will form a route between Chicago and Buffalo about 495 miles long, which will be just about the length of the route by the Canada Southern & Chicago, and also by the Michigan Central and Great Western, when the new Air Line is completed.

The third project is that of the Baltimore & Ohio Company for a new line from Pittsburgh to Chicago. It may be said that this should be excluded from an enumeration of routes between Chicago and New York, as this line is proposed for the purpose of opening a new route between Chicago and Baltimore. It is true that the Baltimore & Ohio Company can reach New York

from Pittsburgh only by an indirect route, and it is further true that the lease of the New Jersey roads by the Pennsylvania Railroad Company may greatly increase its difficulties in carrying traffic to and from New York. But with a line to Chicago, and the traffic from it which will seek New York, this company will be pretty sure to find some better connection with that city, either through a new road or by some of the lines extending into Eastern Pennsylvania. As a New York route, however, it can hardly be a formidable rival to the other lines, for it will probably be considerably longer than any we have named, and, east of Pittsburgh, will have heavy grades.

The new lines to Buffalo, will encourage new lines thence to New York. A company has lately been formed to construct such a road pretty nearly on the line of the New York Central & Hudson River. Only the first steps have been taken by this organization, which is known as the "New York, West Shore & Chicago Railroad Company." But a large part of the work has been done on one road which may form an important link in a new route between the Niagara River and New York. This is the New York & Oswego Midland Railroad, which is to be completed in a few months. From Oswego to the Niagara River, at Lewiston, the Lake Ontario Shore Railroad Company is about to commence the construction of a road which will be 143 miles long, which, added to the 313 miles of the Midland, gives a route from the Niagara to New York 456 miles long—a little longer than the New York Central route. This line can connect most readily with the main line of the Great Western; to connect with the Canada Southern a branch about 20 miles long southwest from Lewiston would be necessary.

The Lake Ontario Shore Railroad is projected primarily as a link in a new line from Chicago to Portland, on the more eastern sections of which some work has been done, but which is hardly likely to gain any strength by its endeavor to obtain national aid. The proposed line is about 1,030 miles long, and would make Portland just about as near to Chicago as Boston now is. It would be better as a through than as a local route, the population on the line being much less than on the existing lines through New York and New England, and its success will depend chiefly on diverting grain and provision shipments from New York to Portland, which will hardly be done in our day.

There is a disposition, we believe, to exaggerate the importance of through lines to the East, or at least of their functions as carriers to and from seaports. Men often argue as if the entire produce of the country was sent across the Atlantic, and all the merchandise consumed in the interior came from beyond it. The great market for the produce of the West is in the Eastern and Middle States. We need more facilities for reaching the manufacturing towns and villages of these States more than we want new outlets to the seaboard, and the value of these new lines should be estimated accordingly. If they will bring Western products to and take manufactures from such towns as Syracuse, Oswego, Albany, Troy, Rutland, Springfield, Worcester, Lowell, Providence, Pittsburgh, etc., cheaper and better than has been done hitherto, they will have a value exceeding any that transportation for shipment to Europe can give them.

THE IMPERIAL LIVNY RUSSIAN NARROW GAUGE RAILWAY.

Mr. Fairlie's letter published in the GAZETTE of last week contains some statements in relation to the above railroad which doubtless have attracted the attention of our readers. If a railroad of 3-feet 6-inch gauge can be built and equipped for less than two-thirds the cost of one of 5 feet of the same character, and if cars of the same plan will carry 2.8 times their weight of freight on a narrow gauge, and similar cars on a 5-feet-gauge road carry a load only equal to their own weight, then Mr. Fairlie has made a very strong case in favor of a 3-feet 6-inch gauge, in preference to one of 5 feet. But it is because we think his statements do not furnish us with sufficient data for an intelligent comparison that we refer to his letter again. If, for example, freight is carried on four-wheeled platform cars on the 3-feet 6-inch gauge, and on eight-wheeled double-truck or bogie cars on the wide gauge, then the reduction in dead weight is due, in part at least, not to the gauge but to the plan of car. If Mr. Fairlie has exercised his skill in designing the cars for the narrow gauge, and has thus reduced their weight, it may be that the same exercise of skill in the construction of 5-feet gauge cars might reduce their weight to nearly the same extent. The building of *a* narrow-gauge road for less than two-thirds the cost of another of a wide gauge, does not prove that another wide-gauge road might not be built for much less than the first. That the 5 feet road whose cost has been compared with that of the Livny line is "the most cheaply constructed broad (5-feet) gauge line in Russia," does not alter the question in its logical aspects, because the most cheaply constructed line in Russia may be very expensive compared with one which might be built there or elsewhere. The new white marble court-house in New York has cost many thousands, if not millions, of dollars more than the one built of gray marble in Chicago, but that is no evidence that grey marble is a cheaper building material than white, because neither the designs of the building, nor the conditions, under which the materials were used are alike. On Broadway, fronting on Eleventh street, are two store fronts of exactly the same design and size, one built of iron, and the other of stone. A comparison of their cost would be some indication of the economy of stone and iron for building purposes. So, in order to make a comparison which will have any value, of the relative cost of wide and narrow-gauge railroads, the conditions must be the same in each case, a point with reference to which Mr. Fairlie's letter does not give us as much information as we would like. We do not doubt that roads equipped with heavy rolling stock, and laid with rails to correspond, will cost much more than lines having only a light superstructure and equipment. The whole question, therefore, quite naturally resolves itself back to that of the weight of cars in proportion to their carrying capacity, If they can be built for a 3-feet 6-inch gauge to carry 2.8 times their weight, and if made for the same service of a similar plan and of equal strength for a 5-feet gauge they will carry a load only equal to their own weight, then a lighter superstructure can be used for the former than for the latter, and the advocates of the narrow-gauge have proved their case, and there is little more to be said for the other side. Thus far the best which has been done in this country is to show that a four-wheeled car on a narrow-gauge road at a slow speed will carry more than an eight-wheeled car on a wide-gauge road at a high speed.

In Mr. Fairlie's letter, he says that, in Russia, trains which weigh (exclusive of engine) 91 tons "daily" perform a duty of carrying 254 tons of freight. We are not quite sure whether he means that the actual load carried by these trains will *average* this amount each day, or whether that is the average *capacity* of the cars.

Inasmuch as this question of the merits of narrow-gauge roads is of great importance in this country, and its discussion is attracting much attention, we trust that either Mr. Fairlie or some of the distinguished friends to whom he has referred in his letter will favor us with some fuller description of both the 3-feet 6 inch and most cheaply constructed 5-feet-gauge roads in Russia. In order that we can compare them, we should know something about the character of the rolling stock, *i. e.*, have a description of the different kinds of cars in use, their weight, and the number of each kind on each road, the size of their wheels, and whether with or without double bogies. In order to compare the cost of construction we should also know of each road, the weight of rails, length and size of cross-ties, width of roadway at grade line, on embankments and in cuts, minimum radius of curves, and the average speed at which the trains run, and also their speed on the shortest curves. Will either Mr. Fairlie or some of the gentlemen to whom he refers favor us and our readers by giving these data?

Bessemer Steel in Chicago.

On Friday of last week the new Bessemer steel works just erected in the southwestern part of Chicago by the Union Rolling Mill Company were exhibited to a party of gentlemen, who were shown there the process of making Bessemer steel. The works had been completed but a day or two, and the machinery had been tried but a few times previously. The works are owned and managed by substantially the same parties who own the Cleveland Rolling Mills, where Bessemer rails have been made with success for some time. The Chicago works are quite similar in design to those in Cleveland, but some improvements have been made in the machinery and its arrangement.

The plant consists of two Bessemer converters, five cupola furnaces for smelting pig iron, and a furnace for spiegeleisen, and on this, almost its first trial, it worked with a smoothness and certainty which left nothing to be desired. It is intended to produce, on an average, eighty tons of Bessemer ingots daily, which will be rolled into rails at the company's rolling mill, near by.

The metals used in these works are Lake Superior charcoal pig, Iron Mountain pig, smelted at this company's furnace in Knightsville, Ind., with the excellent Brazil block coal, and, of course, the German spiegeleisen. The cost of the Lake Superior pig iron in Chicago is said to be nearly the same as in Cleveland. The cost of fuel is somewhat greater, but the improvement of the routes to the Indiana block coal field is likely to somewhat reduce the cost of a material which will be of the greatest service in all iron works in this vicinity.

We hope soon to be able to present a full description of these works, and the peculiar advantages and disadvantages attending manufactures of iron in this vicinity.

Cheap Railroads.

We copy the following extracts from a communication written by Mr. T. McDonough and published in the Orange (N. J.) *Journal*. The object of the letter was to show how that part of New Jersey embraced within a circuit of twenty miles of New York could be made most accessible to persons doing business in the city:

I propose to consider whether a special system of railroads may not be commenced, and gradually completed as fast as required, that will not conflict with the interests of those already built, but on the contrary assist them, and at the same time render every acre of the twenty-mile area available for residences, in the manner best suited for convenient access. They should be so arranged as to enable the through lines to confine themselves to their proper business, and to leave the carriage of commuters entirely to the new class of roads, the trains from which should make use of the present lines as giving the easiest access to the city, until new direct lines, independent of them, are required.

The new lines to be constructed are to be specially adapted to quick passenger traffic, with all the experience derived from the narrow-gauge roads of Wales, Germany and Norway, and to resemble them in equipment, but not in the narrow guage, which is not suited for cars to run partly on the present roads, nor to the demands of persons accustomed to the spaciousness and comfort of the cars now in use. The equipment of the new class of roads is to consist of engines weighing not more than eight or ten tons instead of twenty tons or over, as at present, with their tank for water on the engine frame behind the boiler, but dropped close to the ground, and an additional truck, so as to allow the machine to move either end foremost indifferently. No turn-tables would be required, nor any delay at the end of the route for such an engine, as it could be instantly switched off, and take its place at the opposite end of the train so as to head it on the return trip. To this is to be tightly coupled a train of cars, each 25 feet long, made to carry forty passengers, seated as now in the long cars; to be in other respects similar to horse cars. These, as they are now made, weigh two tons, and are intended to seat twenty; but as they are continually loaded with forty or more with safety, it may be assumed that if one ton additional weight should be used in lengthening their middle section nine feet, and in strengthening them, that a three-ton car can be made to carry forty passengers with safety. The cars on the Festiniog Railway weigh one and a half tons, carrying twelve passengers. They run regularly at twenty miles an hour, and sometimes at more than thirty, so that the lightness of the car would not seem to render it unsafe; especially as its center of gravity would be some two feet lower than that of the long car.

With such an equipment the weight of rail need not exceed 30 lbs. per yard (that now in general use weighs 56 lbs.) With other parts in proportion a superstructure may be available costing not more than $5,000 per mile. By thus reducing the cost of road and equipment to a minimum, the expense of operating is reduced to so low rates as to surprise those who have not examined the matter carefully.

Apart from maintenance of roadbed, the cost of running a train is comprised in two elements, that of wages by the day, and that of fuel, oil and repairs by the mile. On a well managed road, a train to run 100 miles a day costs $17.07 a day for the first item, and 33 cents a mile for the second.

These can both be very much reduced for the proposed train, which will require fewer hands, and will be only one half the weight of a train of long cars. It is not impossible to reduce the expense so much that omnibus fare will repay for any distance within the twenty mile area. And by combining the economy of the horse-car, in dead weight hauled, with the economy of steam over horses (which is only one-sixth as expensive a power), the cost of carrying passengers may be reduced to a very small amount. Some of the London roads now carry by the week on special trains, at the rate of four and one-sixth cents for twenty miles.

Since trains are actually run at such low prices, it would seem that they ought to be applied so that every mile of the area being made accessible in time and money, at the lowest possible rates, the country may be made so nearly a part of the city that its acres may be preferred to city lots for residences.

With the present radiating lines, which are at an average distance of eight miles apart at the twenty mile limit, to be used as direct approaches to the city, let a series of light roads be constructed as belt roads, to join them; to run in the valleys, on nearly level grades, on cheaply turnpiked roads, laid about two miles apart, and parallel to the rim, of which the present lines may be called the spokes. Such lines can be built very cheaply, as they will run with the grain of the country, not crossing the water courses and requiring but little bridging. Trains on such roads could be run hourly, or even more frequently from the points nearest to the city, and the roads should be worked more like horse railroads than as the present steam roads now are, making very frequent stops, and being so arranged that passengers could be carried within a few minutes' walk of their homes, at every point on the several lines, by paying as they do now on the omnibus lines.

The Literary Tastes of our Journeymen Engineers.

Working engineers, more especially those employed in great workshops such as those at Woolwich, Swindon, Crewe, etc., are generally supposed, at any rate by outsiders, to be considerably superior to the average British workman in culture and intelligence. Judging from frequent illusions met with in newspapers and magazines, it seems to be a prevalent impression that the artizan of this class is a man who knows the value of education, spends his leisure hours in study, and not only reads and appreciates scientific books bearing upon his own particular handicraft, but is also given to the study of the literature of the day, and is assiduous in pursuit of that vague something known as "general information." This notion may be a true one: we hope it is; but appearances are against it, if we are to judge by certain statistics to which we have lately had access, which refer to the kind of books most in favor with the workmen of Crewe.

As some of our readers are perhaps aware, there exists, at that famous center of mechanical industry a large Mechanics' Institute, supported by the London & North Western Railway, for the use of the workmen employed at the Crewe Locomotive Works. The members of this institution, as very seldom happens in the cases of similar institutes elsewhere, are nearly all *bona fide* working men, and most of them are engine fitters and turners and constructors in the employ of the company. An inspection of the returns of issues from the institute library, supplemented by certain private information supplied to us, would seem to give reliable indications of the literary pursuits and tastes of journeymen engineers—at least of those at Crewe. The first thing that strikes us in going over the statistics, and comparing them with the information in our possession, is the fact that the higher class of general scientific works is hardly ever read at all. Such works as Roscoe's *Spectrum Analysis*, Tyndall's *Sound*, Lyell's *Antiquity of Man*, are very, very seldom taken from the library shelves, and when they are taken out, as we are informed, they are brought back in a day or two with loud complaints that they are dry reading. We observe that Lyell's *Antiquity of Man* has been issued twice in two years; Grove's *Correlation of the Physical Forces* once in twelve months; and Ganot's *Physics*, three times in a year and a half. Even books directly useful to a mechanical engineer in his own trade are not made use of by the workmen proper. When they *are* borrowed it is almost always, strange to say, either by foremen or apprentices. Thus, in the year 1870, Bourne's *Catechism of the Steam Engine* was issued thirty-nine times; but in only seven instances out of the thirty-nine was it borrowed by persons over twenty-one years of age. Nasmyth's *Elements of Mechanism* was borrowed three times during the same year, and not once by an adult member. Nystrom's *Mechanics* was asked for once; Rankine's *Applied Mechanics*, twice; Goodeve's *Mechanism*, three times, in all cases by apprentices. On the other hand, *Lady Audley's Secret* was borrowed 49 times; *East Lynn*, 44 times, and the *Woman in White*, 61 times. In each case two-thirds of the issues were to grown men, the remaining third to women; and the younger generation of novel-readers appear to delight in such mental pabulum as the *Tiger Hunter*, *White Scalper*, *Bruin*, and the like. High-class standard novels fare no better than standard scientific works, as the following returns for 1870 show: *Romola* issued twice; *Adam Bede*, four times; *Scarlet Letter*, three times; *Leila*, twice. The Rev. Charles Kingsley may be surprised to hear that *Hypatia* has only been wanted once, and *The Water Babies* not once. Perhaps, however, it will console him to learn that the once-famous *Caleb Williams* of the philosophic Godwin has not been issued for more than three years. In point of fact, from what we can gather, and judging at least from Crewe, the ordinary mechanical engineer of the present generation dislikes scientific books, and those who read them. He is quite content to go on as his father did, and to do his work by the rule of thumb, not knowing or caring why he does it; and viewing with suspicion and dislike those who would persuade him to acquire some knowledge of the science of his craft—a knowledge which is possessed by the majority of his brethren in Germany and France.

It is satisfactory to know that the coming generation of working engineers promises to be a far more highly educated class than their predecessors. The statistics before us show that the scientific and engineering works borrowed from the Crewe institution are in the large majority of instances taken out by youths under twenty, and that nearly all the members under twenty are apprentices in the locomotive works. This would seem to show that if the movement in favor of technical education cannot reach, or much affect, the adult journeyman, it nevertheless has good materials to work upon in the case of the journeyman-to-be.

In looking over these statistics the question suggests itself, "Does not the indifference of the artizan to standard scientific books arise from his ignorance concerning them?" for we find that any book of which the Crewe workmen come to know something, immediately becomes popular amongst them. Of course the mere title of a book appearing in a catalogue conveys to the uninstructed man no notion of its use or value. But let him come to know something about it, or about the subject to which it relates, and he will get the book if he can, and read it. When he learns something of the theory and science of his profession, then he will begin to read the books which have been written upon it. This is why the apprentice reads the books on technical subjects, and the middle-aged journeyman does not. In the large and flourishing classes of the Mechanics' Institute the apprentice acquires some knowledge of the theory of his craft, while the journeyman, as a rule, is destitute of such scientific knowledge.

The fact that the Crewe workmen will not read books about which they know nothing, may also account for the erratic nature of their historical and biographical studies. They have all heard of Wellington and Nelson, therefore the *Life of Wellington* is borrowed on an average about once a fortnight, and the *Life of Nelson* about once a week; the naval hero being about twice as popular as his military compeer. Marlborough, having passed from memory to tradition, his memoirs are asked for about once in twelve months. How much the journeyman engineer cares concerning literary celebrities may be gathered from the fact that Lockhart's *Life of Scott* is issued on an average once in nine months; Forster's *Life of Goldsmith*, once in two years; Boswell's *Johnson*, once in twelve months; and Carlyle's *Lives of Schiller and Stirling*, once in five years. In history, Dr. Russel's *Letters from the Crimea* have, in the last few years, been issued about five times as often as Kinglake's stirring account of the same events. Grote's and Thirlwall's *Histories of Greece* are both in the library, but no volume of either has been issued for the last five years. An account of the *Siege of Lucknow*, by an obscure author, is shown to have been borrowed twenty-seven times in the year 1870, while during the same period the first volume of Carlyle's "*French Revolution*" was only borrowed twice, and the second volume not at all. It is evident throughout that the best books are in the least demand. What *can* we say to such returns as the following, respecting the comparative popularity of the different historians of our own country. In 1870, Macaulay was issued 29 times; Hume and Smollett, first volume, 3 times, second volume, once, the remaining volumes not at all; Hallam, first volume, once, the remaining volumes not at all; Thierry's *Norman Conquest*, once; A'Becket's *Comic History of England*, 15 times, and Guizot's *English Commonwealth* not at all.

We notice as a set-off against the brilliant but inaccurate Macaulay's popularity as an historian, that his "*Essays*" were only asked for once during the year.

Not the least noticeable thing in connection with these figures is the apparent impossibility of getting through more than one or two volumes of a long historical work. In works consisting of more than two volumes, the reader seems generally to come to a standstill at the end of the first or second. Even the fascinating Macaulay cannot induce more than about half his readers to keep him company to the end of his work, while in the case of the longer and "heavier" histories it is rare indeed for a Crewe reader to get as far as the third volume. Taking the year 1870 again, we find that the first volume of Thiers' *Consulate and the Empire* was issued twice, the second once, and the remaining volumes not at all, and the same results are shown in the case of Bancroft's *United States*, Ranke's *Lives of the Popes*, and other works. In the year 1869 the first volume of Allison's *Europe* appears as having gone out twice, and the remaining 19 volumes once each; some monster of perseverance—who ought to have a statue at once, *i. e.*, if he survived the effort—having actually toiled right through this dreariest of mortal writings.

Turning to the statistics relating to the issue of books in the department classed as "general literature," we notice that what may be called the literature of "getting on" is comparatively very popular amongst the Crewe workmen. We refer to such books as Smile's *Self-Help*, *Men who have Risen*, and works of a similar aim. *Self-Help* appears to have been issued thirty-four times last year; *Better Days for Working People*, fifteen times. Naturally as a man tries to get on he seeks at the same time to fit himself for the better society in which he hopes to mix, therefore we are not surprised to see that such books as *Habits of Good Society*, *Art of Conversation*, etc., are fully as popular as those of the *Self-Help* kind. It may seem strange that a journeyman engineer should prefer to study the *Habits of Good Society* to making himself master of such a book as Burchett's *Practical Geometry*, yet it is a fact, nevertheless, that the former was borrowed in 1870 nine times as often as the latter. We are less surprised to find that the Crewe readers do not care about essays. John Foster has not been taken from the library for upwards of three years; a volume of Carlyle's *Miscellaneous Essays* is asked for on an average about once in nine months; and Emerson's *Essays* have not been issued since 1868. Even the gentle cooings of A. K. H. B. are not responded to as heartily as one might expect, for *Recreations of a Country Parson* was borrowed but twice in 1870; but even that was twice as often as the "*Recreations*" of the rollicking Christopher North. Such is literary fame!

As might be anticipated, there is no demand in Crewe for theology. Butler's *Analogy of Religion* (the Grammar of Religion) has been issued once in five years; Paley's *Natural Theology*, once in two years; Robert Hall's *Sermons*, once in eighteen months; Paley's *Evidences of Christianity*, once in twelve months, and the less known biblical and theological works in something like the same proportion.

The statistics referring to the newspapers and periodicals most in demand in the reading room furnish indications as to the literary tastes of the Crewe readers, somewhat similar to those furnished by the library. The really high-class papers are *not* the most in demand. If you visit the room at night you may wait an hour for your turn of the *Daily Telegraph*, but the chances are that you will find the *Pall Mall Gazette* at liberty whenever you want it. Where one man reads *Macmillan's Magazine* twenty reads the *Family Herald*. For the sake of experiment the librarian has occasionally left the leaves of *Frazer* or *Blackwood* uncut, and the readers have never found out the fact. He has tried the same experiment with the *Cornhill* and others, and shortly after he has found the leaves cut of that portion only containing the installments of the serial stories. A fitting corollary to this may be found in the fact that *Bell's Life* has at least as many readers as the *Saturday Review* and *Spectator* put together.

After all, the literary tastes of the journeymen engineer are pretty nearly the same as those of other workmen. In the matter of sobriety, thrift and general propriety of bearing, he is probably superior to the artizan of any other department of labor. In respect of mental culture and literary knowledge, he has nothing to boast of over his fellows. When he does read, it is for amusement rather than for information, and he has an insuperable objection to anything dry. Never having been disciplined to systematic study, it is impossible for him to sit down and laboriously puzzle through a chapter of a learned treatise, the practical bearings of which on his own work he cannot see. When the blessing of a sound, practical education shall have been brought within the reach of everyone, and when no man shall be able to call himself a skilled workman until he shall have gone through a systematic course of thorough technical instruction, then a very different tale may have to be told of the literary taste of our journeymen engineers.

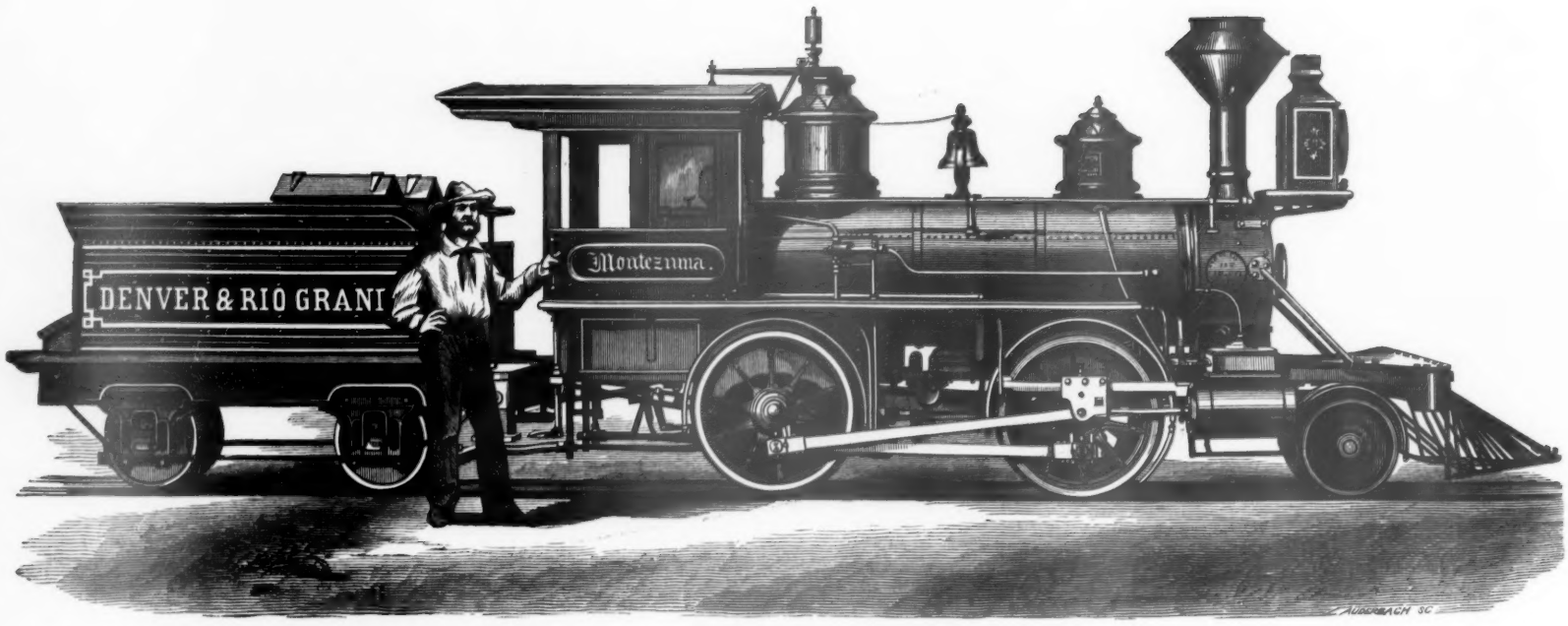
We are led into a wide field of speculation as to what curious revelations might result from a peep into the arcana of Mudie, Bull, and other librarians, in relation to the literary habits, tastes, and culture of the upper and middle classes. Would the comparison result entirely in their favor? Recent comments on similar returns as to the British Museum Library, which have appeared in the daily press, would indicate that it is not *only* the journeyman engineer who reads for "amusement rather than for information," to whom the study of the habits of "Good Society," and the "Art of Conversation" would be beneficial; who forsakes Guizot, Thiers and Hallam, for Macaulay, and who certainly does *not* enter Alison at the beginning and issue triumphant at the end—like the artificer whom we hope we have immortalized as one of our "Famous Mechanics Unknown to Fame." Are there not males of the "Upper Ten" to whom Tattersall's is more than the Royal Institution, the Bibury Club than the British Association, and *Bell's Life* than the *Spectator* plus the *Saturday Review*.—*Mechanics' Magazine.*

The Effect of Curves on Resistance and Cost of Moving Trains.

The resistance offered by curves to the motion of a railway train depends upon the length of the radius, the gauge of the road, the elevation of the outer rail, the form of the rolling surface of the wheels, the arrangement of the mechanism of the cars and engine, and upon the speed and length of the train. To obtain some guide for comparing lines with different systems of curves, or to be able to equate for curvature, we require to know as near as may be the general effect of curves upon the resistance to motion. The facts observed are quite discordant, owing to the great variety in the conditions under which experiments have been made.

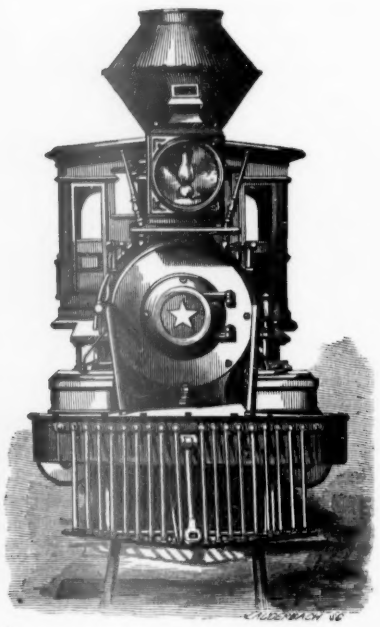
In equating for grades we find first the ascent consuming an amount of power sufficient to haul a train one mile upon a level, or the grade of double resistance. So, too, in equating for curves we require the amount of curvature necessary to consume an amount of power sufficient to haul a train one mile upon a straight line. It is generally assumed that the resistance from curvature is inversely as the radius; that is, that we meet with the same resistance from curvature in running one mile of 2° curve that we do in running two miles of 1° curve. The number of degrees of curvature is the same in both cases. The total resistance depends upon the whole number of degrees traversed, and is independent of the radius or the length of the curve. This, however, is the mere theoretical aspect of the question. As a matter of practice, we are much more concerned with the momentary resistance than with the total resistance. We may distribute 1,000° of curvature in such a manner over 100 miles of road that it shall be practically inappreciable; while if the same total amount of deflection was put into a number of sharp reversed curves, they might affect the capacity of the road to a very material extent. In equating for curvature, therefore, as in the case of grades, any rule for proceeding must be employed under the guidance of experience and common sense.

The average of numerous experiments would seem to show that the resistance upon a 10° curve, or a curve of 574 feet radius, at a speed of 20 miles an hour, is double that upon a straight line. In traversing, therefore, a 10° curve a mile long we should consume an amount of power sufficient to haul a train two miles on a straight line. The length of a whole circle of 10° curve is $574 \times 2 \times 3.1416$, or 3,606 feet; and this contains 360°. The proportionate number of degrees in a mile, or 5,280 feet, is 527, which is thus the number of degrees, whatever the radius, consuming an amount of power which would haul a train one mile on a straight and level road at 20 miles an hour; and this is, therefore, the equating number for curvature, just as 24 feet is the equating number for the comparison of grades at the same speed. But, as in the case of grades, a double expenditure of power does not involve a double cost of transportation. We, however, increase the cost of operation more in doubling the resistance by curvature than we do in doubling it by grades; since the effect of curvature upon the wear and tear of engines, cars, and track, is greater than that of grades. Taking the operation of the 1,500 miles of railway in Massachusetts as a basis, and adding for a double expenditure of power required by curves 25 per cent. to the cost of repairs of the roadway, engines and cars, and 100 per cent. to the cost of fuel, we shall increase the whole expense of operating and maintaining the roads by about 25 per cent. If, therefore, a mile of road containing 527 degrees of curvature demands the exertion of double the power required upon an equal length of straight line, and if the exertion of a double power involves 25 per cent. more expense, the number of degrees consuming an amount of money sufficient to operate and maintain one mile of road will be four times 527, or 2,108°; which is thus the equating number for curvature at a speed of 20 miles an hour. This, number, however, being based upon a double resistance, will vary according to the actual resistance upon a



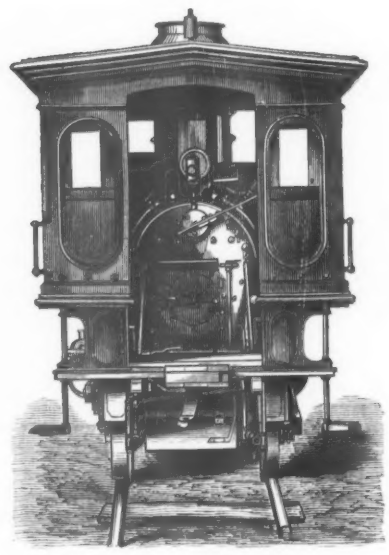
NARROW-GAUGE (3-ft.) PASSENGER LOCOMOTIVE,

Built by the Baldwin Locomotive Works for the Denver & Rio Grande Railway.



DIMENSIONS.

Diameter of Cylinders	9 inches.
Stroke of Piston	16 "
Diameter of Driving Wheels	40 "
" Pony "	24 "
Distance from center of Pony Wheels to center of front drivers	5 feet 8¼ inches.
Rigid wheel-base distance between Driving Wheel centers	6 " 3 "
Total wheel-base of engine	11 " 11½ "
Capacity of Tender	500 gallons.
Diameter of Tender wheels	24 inches.
Distance between centers of Tender wheels	6 feet.
Total wheel-base of Engine and Tender	36 feet 5¼ inches.
Length of Engine and Tender, over all	35 feet 4 inches.
Weight of Tender, Empty	5,500 pounds.
Weight of Engine, in working order	25,300 "
" " on Drivers	20,500 "
" " on each pair of Drivers	10,250 "
" " on Pony Wheels	4,800 "
Height of Smoke-Stack above rails	9 feet 9 inches.
Height of Cab from Foot-board to center of ceiling	6 " 3 "



straight line; and thus according to the speed, as shown in the following table, in which column 3 gives the radius of the curve upon which the resistance is double that upon a straight line; column 4, the corresponding number of degrees of deflection in a mile; and column 5, the equating number in degrees.

Speed in miles per hour	*Resistance in lbs. per ton.*	*Rad. of curve of double resistance.*	*Corresponding No. deg. per mile.*	*Equating No. in degrees.*
15	9.3	636	476	1,904
20	10.3	574	527	2,108
25	11.6	510	593	2,372
30	13.3	444	681	2,734
40	17 3	343	884	3,535
50	22.6	261	1,159	4,636

The radii in column 3 are made inversely to the resistance in column 2, and the number of degrees in column 4 are found by the proportion—Length of circle (col. 2): one mile : : 360 : No. column 4. The final numbers are four times those in column 4. Thus, if we have two lines, one 100 miles long, with 4,216 degrees of curvature, and the other 98 miles long with 8,432 degrees of curvature, the distance would be:

$$100 + \frac{4,216}{2,108} = 102$$

$$98 + \frac{8,432}{2,108} = 102$$

If we assume the cost of operation to be as the equated length, we may compare different routes by adding in each case the cost of construction to the operating expense of the equated length capitalized.

In arranging the grades upon any route, we may often so oppose the lightest ascent to the heaviest traffic that the resistance shall be the same in both directions; but a curve does not admit of being adjusted to a traffic preponderating in one direction, since the assistance is the same in which ever way we traverse it. We may in some cases combine the sharper curves with the easier grades, and the larger curves with the steeper grades, so as to establish a somewhat uniform maximum or ruling resistance upon the road; but generally the same natural features that demand steep grades require at the same place sharp curves.

If we would make the resistance upon any system of grades and curves uniform, where a curve occurs upon a grade we should flatten the latter to an amount sufficient to compensate for the resistance caused by the curve. We have assumed a 10° curve to cause a resistance equal to that caused by a grade of 24 feet per mile; in which case 2.4 feet per mile per degree of curvature would be the flattening upon the grade that the resistance may be uniform. The following table shows the amount of flattening required upon grades for curves of different radii, the speed being 20 miles an hour. *R* being the radius of the curve in feet, and *F* the flattening of the grade in feet per mile:

R.	*F.*	*R.*	*F.*	*R.*	*F.*
5,730	2.4	819	16.8	443	31.2
2,865	4.8	717	19.2	410	33.6
1,910	7.2	637	21.6	383	36 0
1,433	9.6	574	24.0	359	38.4
1,144	12 0	522	26 4	338	40.8
995	14.4	478	28.8	320	43.0

At different speeds, the numbers would of course vary, as the resistance depends upon the velocity: thus the following cannot be adapted to all classes of trains upon a road, but it should be made as nearly as possible to suit the average requirement. Upon the Pennsylvania Railroad the grade was reduced at the rate of 1½ feet per mile per degree of curvature, or 9 feet for a 6° curve. Upon Mr. Ellet's Mountain Top Track in Virginia it was found that with a six-wheeled connected-tank engine, weighing 50,000 pounds, a difference of 58 feet per mile between the grade adopted on a straight line and that used on curves of 300 feet radius was not sufficient to compensate for the increased resistance due to curvature. The result, however, with an engine better adapted to curvature, would be different. The immense 40-ton eight-wheeled connected engines upon the Lehigh Valley road, with the Bissell truck, traverse sharp curves with great ease. Upon the Central Pacific Railroad the grades have been reduced from 2 to 2½ feet per mile per degree of curvature on curves of from 2° to 9° of deflection. On the Baltimore & Ohio Railroad the 116-feet grade was reduced to 110 feet upon curves of 600 feet radius, and is increased to 121 feet upon curves of 1,000 feet radius.

From what has been said it may be seen how important it is to guard against the introduction of grades and curves without carefully considering their cost.

When the Pennsylvania road was built, a mile of distance saved was reckoned worth $53,000; or $10 a foot. If a road costs $40,000 a mile, and the cost of maintenance and operation is $10,000 a mile, we might pay $206,666 to shorten the line one mile; or according to Mr. Haupt's method, if the expenses which increase with the length of the road amount to a dollar per train mile, with 10,000 trains per annum we should have a capital of $166,666; with 20,000 trains a year, a capital employed of $333,333; and so on, showing a very rapid increase in the amount to be spent in shortening a line as the amount of work to be done increases. In estimating the amount to be spent in reducing grades or curves we are of course to regard the effect of these elements upon the cost of operation in the same manner as above stated in the case of simple distance; but the interest upon the cost of *construction*, which applies to *distance*, does not apply to grades or curves. Thus while 162 feet of ascent or 2,108 degrees of curvature might be regarded as equivalent to a mile of distance in the matter of operation, they are less objectionable by the amount of interest upon the cost of building a mile of road.

It may not, though, be advisable, in most cases certainly *is not* advisable, to make so great an outlay at the commencement of construction as the above figures would indicate. After a road has been brought into good condition, when the traffic has become well established and attention is given to obtaining the greatest economy of operation, the minor faults of location which with a new and rough road and an undeveloped business were not appreciated, make themselves felt, and thus point out the way for bringing the line into a state of greater efficiency.—*American Railway Times.*

Narrow-gauge (3 feet) Passenger Locomotive, by the Baldwin Locomotive Works, for the Denver & Rio Grande Railway.

This locomotive, with two others for freight service, has just been completed at the Baldwin Locomotive Works, and by the time this meets the public eye will undoubtedly be at work on the pioneer narrow-gauge line in the United States. As this machine is entitled to the designation of the first narrow-gauge passenger locomotive built or operated in this country, a brief description of it will be of interest both to the railroad and general public.

Its dimensions are as follows:

Cylinders	9 inches diameter.
Stroke of piston	16 inches.
Diameter of driving wheels	40 "
" " pony wheels	24 "
Distance between center of pony wheels and center of front drivers	5 feet 8½ inches.
Distance between driving-wheel centers	6 feet 3 inches.
Total wheel-base of engine	11 feet 11½ inches.
Rigid wheel-base (distance between driving-wheel centers)	6 feet 3 inches.
Capacity of tender	500 gallons.
Diameter of tender wheels	24 inches.
Distance between centers of tender wheels	6 feet.
Total wheel-base of engine and tender	26 feet 5½ inches.
Length of engine and tender over all	35 feet 4 inches.
Weight of tender empty	5,500 pounds.
Weight of engine in working order	25,30) "
" " " on drivers	20,500 "
" " " on each pair of drivers	10,250 "
" " " on pony wheels	4,800 "
Height of smoke stack above rail	9 feet 9 inches.
Height of cab from foot-board to center of ceiling	6 feet 3 inches.

It will be seen that the rigid wheel-base is given as 6 feet 3 inches, the distance between centers of driving wheels. This is due to the fact that the leading or pony wheels are fitted with a swing bolster and radius bar, allowing them to move laterally under the engine in passing curves. These wheels are also equalized with the front pair of drivers. By this arrangement, while the pony truck assists in guiding the engine on a curve and so relieves the front pair of drivers from the excessive wear of tires which would otherwise result, the rigid wheel-base is reduced so that the engine will pass curves of very short radii without difficulty. It is, in fact, only about two-thirds that of the four-wheeled cars designed and built for the same road.

As much interest attaches to the subject of the speed practicable on narrow-gauge roads, we may remark that the proportions of this machine are such that it develops the same total travel of piston in going one mile as does a locomotive having 24 inches stroke of piston and driving-wheels 5 feet in diameter. It is therefore apparent that equal, or nearly equal, speeds are possible with this engine as with the engine of the usual pattern on the full gauge, *i. e.*, 24 inches stroke and 5 feet drivers.

The plan of this engine gives somewhat more than four-fifths of the whole weight on the drivers, so utilizing it for adhesion. Its tractive power on a good rail, exclusive of the resistance of curves, is as follows:

On a level	512 gross tons.
" a grade of 40 feet to the mile	164 " "
" " " " 80 " " " "	98 " "

From these figures should be deducted 17 gross tons, the weight of the engine and tender in working order, to get the total weight of cars and lading which can be drawn on a level or on the grades named.

The freight locomotives built for the same road have three pairs of drivers and a swing-bolster pony truck. Their cylinders are 11 inches diameter and 16 inches stroke; drivers, 36 inches. The total weight of engine in working order is 33,500 pounds, of which about 29,000 pounds are on the drivers. Being distributed to three pairs of wheels, the weight on each pair of drivers is a little less than 10,000 pounds, nearly the same result as with the passenger engine.

We hope to give a full description of the freight locomotive also at an early day.

—The Commissioner of Patents is engaged in thoroughly revising the rules of practice before the Patent Office and a few important changes will be made. Among these may be enumerated a change in the rule heretofore governing the oath required of inventors on filing a claim for a patent, to the effect that they were the original inventors of the invention offered for a patent, and upon the office granting a patent allowing attorneys to modify the claim according to the testimony of the patent examiners. It is now proposed that every applicant shall, upon the granting of the patant, be required to take an oath in support of the claim as allowed, and not as originally advanced. This will, in case of litigation, confine parties strictly to what they are entitled to claim, and not allow them to prosecute on the broad claim as filed in making the application. The oath as now required will be exacted, but supplemented in accord with the claim allowed.

General Railroad News.

ELECTIONS AND APPOINTMENTS.

—William Lorenz, late Chief Engineer of the Lebanon Valley Railroad, has been appointed Chief Engineer of the Philadelphia & Reading Railroad in place of Charles E. Byers, deceased.

—The directors of the Grand Rapids & Indiana Railroad, at a meeting held at Fort Wayne August 1, elected Wm. A. Howard, of Grand Rapids, President, and Wm. R. Shelby, Secretary and Treasurer of the company, the offices to be located at Grand Rapids, Mich. They decided on locating the shops of the company at Big Rapids, 55 miles north of Grand Rapids. Wm. A. Howard, the new President, succeeds Joseph K. Edgerton, of Fort Wayne. He was formerly member of Congress from the Detroit district, and last winter a prominent candidate before the Legislature of Michigan for United States Senator, and has been for two or three years past Land Commissioner of the Grand Rapids & Indiana Company. The new Secretary and Treasurer succeeds John M. Godown, of Fort Wayne.

—O. H. Beach, of Mansfield, O., has been appointed Superintendent of Telegraph of the Pittsburgh, Cincinnati & St. Louis Railway, as well as of the Pittsburgh, Fort Wayne & Chicago Railway. He has thus the management of all the lines operated by the "Pennsylvania Company"—more than 2,000 miles, with 205 offices.

—It is reported that W. D. Griswold, Superintendent of the Ohio & Mississippi Railroad, has been tendered the management of the Toledo, Wabash & Western Railway.

—Col. E. B. Beaumont, of Memphis, former Chief of Police of that city, has been appointed General Agent of the Memphis & Kansas City Railroad Company.

—At a meeting of the stockholders of the Michigan Midland Railroad Company, held at St. Clair, Michigan, July 25, the following named persons were elected directors: John E. Kitton, John L. Agens, Diodorus Sheldon, Henry Whiting, Robert H. Jenks, Michael Ayer, Wm. A. Thomson and Nelson G. Isbell. At a meeting of the directors subsequently held, John E. Kitton was elected President; Geo. F. Collins, Secretary; Robert H. Jenks, Treasurer, and John C. DeCosta, Chief Engineer.

—At the adjourned session of the annual stockholders' meeting of the Burlington & Missouri River Railroad Company, last week, the following Board of Directors was elected, being the same as last year, with the exception of Mr. C. E. Perkins, who was elected in place of Mr. E. D. Rand, of Burlington, Iowa: Nathaniel Thayer, J. M. Forbes, J. W. Brooks, R. S. Watson, Alpheus Hardy, John A. Burnham, Boston; Erastus Corning, Albany; James F. Joy, Detroit; C. E. Perkins, Burlington, Iowa.

—The following directors have been chosen for the newly organized Indianapolis & Northwestern Railroad Company, which succeeds the Indianapolis, Delphi & Chicago Railroad Company: Dr. Harvey Kerr, G. A. Kirkpatrick, S. Sheets, J. W. Blake, C. A. Elliott, J. Harper. The following are the officers: President, J. W. Blake; Secretary, C. A. Elliott; J. K. Kappes, Treasurer; with Colonel Harper, Dr. Kerr, and J. H. Kappes as an Executive Committee.

—The directors of the New York, West Shore & Chicago Railroad Company have chosen J. M. Courtenay, President; W. M. Richards, Treasurer; L. M. Guthrie, Secretary, and Charles B. Stuart, Engineer in Chief.

—Mr. C. M. Wicker was, on the 1st of August, appointed Assistant General Freight Agent of the Chicago & Northwestern Railway Company. Mr. Wicker lately resigned a similar position with the North Missouri Company.

—Mr. S. M. Seymour, late Chief Engineer of the Chicago & Southwestern Railway, has been appointed Chief Engineer of the Chicago & Northwestern Railway.

PERSONAL.

—Gen. J. T. Boyle, of Louisville, Ky., President of the Evansville, Henderson & Nashville Railroad Company, died suddenly of apoplexy on the 28th inst.

—J. D. Layng, Assistant General Manager of the Pittsburg, Cincinnati & St. Louis Railway, has removed his office from Columbus to Pittsburgh.

—J. T. Thompson, formerly Superintendent of the Indianapolis, Peru & Chicago Railroad, died at his residence in Peru, Ind., on the 1st inst.

—Mr. James Charlton, now General Ticket and Passenger Agent of the Chicago & Alton Railroad, was lately presented with a fine Howard watch by his late associates of the North Missouri Railroad, during a recent visit to St. Louis.

—Captain Fred. P. Hill, the oldest conductor on the New Jersey Central Railroad, has been retired on a life pension of $80 per month. Before railroads were built he was a stage driver, and was father to the engineer, George Hill, killed at the recent Newark accident.

CHICAGO RAILROAD NEWS.

Michigan Central.

The Atlantic express, leaving Chicago at 5:15 p. m., now runs over the Michigan Air Line between Niles and Jackson, by which the distance is twelve miles less than by the old road.

Chicago & Northwestern.

Two new offices have been created during the week, and appointments made to fill them. While Mr. Dunlap was General Manager of the company he per-

formed also the duties of Chief Engineer. A separate office has now been created, and Mr. S. M. Seymour—lately Engineer of the Chicago & Southwestern road, and some time since connected with the Erie Railway—has been appointed to it.

Mr. C. M. Wicker, lately Assistant General Freight Agent of the North Missouri Company, has been appointed to the same office in this company.

Chicago & Alton.

The Missouri line of this company, from Louisiana to Mexico, is now completed, and one mixed train passes each way daily.

The earnings during the past month—July—show the remarkable increase of about 28 per cent.; $535,842.73, against $418,709.23 during the same period last year.

OLD AND NEW ROADS.

Shenandoah Valley.

Work was commenced some time ago on this road (the Pennsylvania's Shenandoah project), and it was promised that the line should be prosecuted to completion at an early day; but it seems that the work of grading was suspended early this month.

Chicago & Michigan Lake Shore.

This company has agreed to extend its line north from the present terminus at Whitehall to Pentwater, about 20 miles, if local subscriptions to the amount of $50,000 are made in aid, and a company under the title of the "Montague, Pentwater & Manistee Railroad Company" has been organized to prosecute the extension.

Lafayette, Bloomington & Mississippi.

The Bloomington *Pantagraph* reports that a "contract has been entered into with the Toledo, Wabash & Western Company to build the Lafayette, Bloomington & Mississippi road by the 1st of January next from Bloomington to Paxton, and by the July following to the State line."

New York, West Shore & Chicago.

The report of the Chief Engineer of this company recommends the following route: There are three general divisions—Eastern, Middle, and Western. The Eastern extends from Jersey City to Catskill, 110 miles. It lies immediately on the west shore of the Hudson, and has an ascent of an average of four feet per mile.

The Middle Division, from Catskill to Syracuse, is 163 miles in length. At the former place the river bears to the eastward, while the route of the railway continues in almost a direct line to the Mohawk at Schenectady. Thence the route lies along the south side of the Valley of the Mohawk and of the Erie Canal to Utica, and from this place it continues nearly a direct westerly course to Syracuse. The maximum ascending grade, eastward, in the direction of the greatest traffic, will not exceed 20 feet per mile on any portion of the route. From Schenectady to Utica the ascent of 193 feet can be accomplished with grades that will not exceed at any place 20 feet per mile.

From Utica to the western end of this division of the proposed road the character of the grades and work will be generally light. On the south side of the Mohawk there are a less number of streams to be bridged than on the north side. The most important is the Schoharie Creek. The Western Division extends from Syracuse to the International Bridge, at Buffalo, 147 miles. From Syracuse the line continues almost direct to Buffalo, the Erie Canal diverging considerably northward at Rochester.

The new railroad claims to control a frontage of 12 miles along the bulkhead line of New York Harbor.

The estimates contemplate a double-track railroad of 4 feet 8½ inch gauge. Cost of the Eastern Division, $7,655,000; Middle Division, $10,106,000; Western Division, $8,452,500. Total, $26,213,500. The length of the proposed road is 420 miles.

The directors have decided to offer the company's bonds in the European markets.

Union Pacific.

This company has made the following statement of its earnings and expenses for the month of June and for the first half of 1871:

	June, 1871.	*June*, 1870.
Earnings	$728,174 34	$746,540 01
Expenses	279,122 80	419,151 81
Net earnings	$449,051 54	$327,388 20
	Jan. 1 to June 30, 1871.	*Jan. 1 to June 30, 1870.*
Earnings	$3,410,284 58	$3,797,916 09
Expenses	1,686,887 33	2,739,837 69
Net earnings	$1,723,397 25	$1,058,078 40

Thus, with a decrease of 10¼ per cent. in receipts, the company shows an increase of no less than 63 per cent. in net earnings, caused, of course, by the very large reduction of $1,052,150.36, or 38½ per cent. in expense.

Cape Cod Railroad.

At the annual meeting of the stockholders of this company in Sandwich, on the 19th ult., the old Board of Directors was re-elected. The receipts for the year ending May 31, 1871, were $294,466.16, and the expenses $206,198.25, leaving as net income $88,267.91. Of this latter sum, $63,857.50 were paid in dividends; $13,528.75 for State and United States taxes; $13,066.98 for interest; and $13,309.73 was carried to reserve fund account. The dividends for the year, including taxes paid by the company, are equivalent to 9¾ per cent. of the capital stock. A statement of the net earnings of the road for the last ten years shows that these are equal to an average annual dividend of 11 per cent. on the present capital stock, which is $784,620.

Cincinnati & St. Louis.

Trains commenced running between these two cities on the 23d inst. by way of the Cincinnati, Hamilton & Dayton road from Cincinnati to Richmond, and thence by the Pan Handle and the Vandalia roads. The distance is 376 miles—35 miles further than by the Ohio & Mississippi road. These trains daily leave Cincinnati, at 7 a. m., 2 p. m. and 9:45 p. m., reaching St. Louis at 10:50 p. m., 5:40 a. m. and 1 p. m.

Indianapolis & Northwestern.

Under this name the old Indianapolis, Delphi & Chicago Company has been revived, with the design of constructing a narrow-gauge railroad from Indianapolis & Chicago.

Framingham & Lowell.

This new Massachusetts railroad, which is nearly completed, the Springfield *Republican* describes as follows:

"It is nearly 30 miles long, and makes a part of the line from Lowell to Providence, Newport, New Bedford, etc., by which the circuit through Boston or Worcester will be avoided. The saving in distance from Lowell to Providence by the new route, over the route through Boston, is about five miles, but the connections will be close, and there will be no break as now at Boston. The road from Framingham to Lowell passes through a prosperous farming and manufacturing district, running through both villages in Sudbury, through the fast-growing "Factory Village," or "Westvale," in Concord, and through the edges of Acton, Westford and Carlisle, and the middle of Chelmsford. It crosses the Fitchburg road not far from the great muster field in Concord, and will be crossed by the road from Lexington to Brookline, N. H., if that is built, somewhere in Carlisle, probably."

Massachusetts Central.

The Springfield *Republican* says that this road "seems likely to have the needful money advanced, and to be built before the Hoosac Tunnel is opened for travel. The whole stock—$3,000,000—has been subscribed, Northampton taking ten per cent. of it, or $300,000; and as soon as 20 per cent. of this stock—$600,000—is paid in, the work of building will begin at the Northampton end, and the first portion to be completed is the eight miles between Northampton and Amherst. The road was originally to strike the Fitchburg road at the Stonybrook station, in the town of Weston, about 13 miles from Boston, but the last Legislature granted a charter from that point to Boston over a new route, which is very likely to be built within a few years. Sanguine persons expect that Mr. Munson, the contractor, will have the line open from Northampton to Stonybrook within a couple of years, and it is by no means impossible that he will. The idea of getting State aid for the road has been abandoned, which, of itself, is a guarantee that it will be built two years sooner, and for half the cost, than would have been put upon it, if the State had invested its millions there. The President of this road is James M. Stone, of Charlestown, and its most active agent in Western Massachusetts is Mr. Lewis J. Dudley, of Northampton."

Atlantic & Pacific.

A party of engineers and excurtionists under charge of Chief Engineer Blinkendorf, of the Atlantic & Pacific Railroad, will soon start from St. Louis to examine and survey the engineering features of the route across the plains, which it is contemplated the road will take from its present terminus to the Pacific coast. Gen. Pope, commanding this department, will furnish the military escort to the party for protection against hostile Indians. Another party, under the command of Capt. J. R. Straugh, will start about the same time and survey the route to the Candian River, about 150 miles from the present terminus of the road.

Toledo & Louisville.

Efforts are being made to secure the early construction of 63 miles of this proposed road from North Vernon, the northern terminus of the Louisville Branch of the Ohio & Mississippi, northward to Newcastle, on the Fort Wayne, Muncie & Cincinnati road 83 miles south of Fort Wayne. The Fort Wayne, Jackson & Saginaw Company, it is reported, offers to construct, equip, lease and operate the road if $5,000 per mile is subscribed along the line.

Macon & Western.

The Supreme Court of Georgia has decided that the lease of this railroad (Macon to Atlanta) is legal, in a suit for an injunction, forbidding its lease to the Central, of Georgia.

Selma, Marion & Memphis.

General N. B. Forrest has concluded a contract with the Roane Iron Mills Company, of Chattanooga, for 3,000 tons of iron for the road, which has been in operation for some time from Selma, Ala., northwest to Greensboro, and is to be completed this year, it is hoped, to Columbus, Miss.

Milford, Hopkinton & Ashland.

The contract for the grading of this line, from Milford, Mass., nortward about eleven miles to Ashland, has been let to J. J. Powers, of Providence, R. I. It is to be worked with the Milford & Woonsocket Railroad, now in progress, forming with it a line about 22 miles long from Woonsocket northward to Ashland. The Providence & Worcester Company is to lease and operate the line.

Rockford Central.

Messrs. T. S. Battey & Co., of Sterling, Ill., have taken the contract to grade the road from Rochelle to Rockford, 26 miles. Work was commenced, on the 26th of July, about two miles from Rochelle, and it is intended to complete the contract by the 20th of October.

Burlington & Southwestern.

It is expected that trains will be running over this road between Burlington and Moulton, nearly 100 miles, by the middle of September; but only about 55 miles of this will be new road. The track of the Keokuk Branch of the Chicago, Burlington & Quincy will be used between Burlington and Fort Madison, and that of the North Missouri from Bloomfield westward to Moulton, 15 miles.

Boston & Albany.

This company is enlarging the foundation of its bridge over the Connecticut, so as to sustain a new iron bridge with two tracks and a footway between. The masonry is nearly completed.

Louisville, Cincinnati & Lexington.

The gauge of this road is to be changed on Sunday, August 13, from the Southern standard of 5 feet to 4 feet 9 inches. The line is 108 miles long. This is in pursuance of an agreement with the city of Louisville, by which certain desirable privileges were obtained on condition of making the change, and thus compelling all transfers to be made in Louisville which otherwise would have been made in Cincinnati; the Louisville & Nashville Railroad, the only other road entering Louisville from the south side of the Ohio, has the 5-feet gauge, and its connections with other Southern lines are so close and so important that it will not be likely to make a change unless some of these connections change at the same time.

Milwaukee & Northern.

Propositions to subscribe aid for an extension of this road northward from its present terminus at Cedarburg have been voted down in all the towns between Cedarburg and Plymouth, 35 miles, and Calumet County, which covers most of the route from Plymouth to the proposed terminus at Menasha, has voted against a similar subscription.

Cairo & Fulton.

The Little Rock *Gazette* says there are about forty miles of iron now at Argenta for the Cairo & Fulton Railroad. Track-laying will be commenced in a few days. There is a section of 20 miles from Little Rock northeastward completed. Forty miles more will bring the road within 90 miles of the Missouri line, where it is to meet the St. Louis & Iron Mountain road.

Fort Scott & Allen County.

The directors of this company will meet at Humboldt, Kansas, on the 8th inst., to consider bids for ironing and equipping the road. It is said that steps will be taken at this meeting to effect a consolidation with the Fort Scott, Humboldt & Pacific Company, whose directors meet at the same place and time. The proposed road of the latter company would naturally form an extension of the former from Humboldt westward.

Denver & Rio Grande.

The first rail on this long narrow-gauge railroad was laid at Denver on the 28th ult. The rail weighs 30 pounds to the yard. Two freight engines and one passenger engine (the latter illustrated in the RAILROAD GAZETTE this week) have been received, and a number of cars. A considerable amount of iron is on hand, which it is intended to put down at the rate of about five miles per day, at which rate the part of the road from Denver to Colorado City, close to Pike's Peak, 80 miles, which it is intended to have in operation this year, will soon be completed. For this part of its course the new road will be hardly anywhere more than twenty miles from the Kansas Pacific.

New Massachusetts Railroads.

There must be at least 200 miles of railroad line either now building or about to be put under contract in Massachusetts, including the whole extent of the Massachusetts Central, and 50 miles more which will be begun within six months. And there are more than 80 miles so nearly completed on the three lines of the Ware road, the Boston Barre & Gardner road, and the Framingham & Lowell road, that trains will be running over them all within six or eight months. Indeed, the Barre & Gardner road is already open from Worcester to Gardner, and the Framingham & Lowell road has its track nearly all laid, and will have trains running over it, probably, by the first of September. The Ware road is rapidly extending toward Winchendon, to connect with the Monadnock Railroad from Peterboro, and will probably be completed in the course of next winter; and it is by no means impossible that the point in dispute last spring, about extending the Barre & Gardner road to Winchendon, may be temporarily settled by allowing the trains from Worcester to run into Winchendon over the track of the Ware road. * *

Taking all the new enterprises together, there are more miles of new railroad now in progress in this State than for many years past, and the effect of the new lines, when completed, will be to develop a considerable section of the State that has hitherto profited little by direct railroad communication. Several new railroad centers, of the third and fourth class, will be formed by the lines that are building, and the tendency, already established, to build up the small cities and large towns of the interior faster than the metropolis, will be quickened by the movement in railroads now going on. Worcester, Lowell, Taunton, Northampton, Palmer, Winchendon, Concord, Framingham, etc., will benefit greatly by the new routes, and Springfield will lose nothing thereby, nor by the opening of the Hoosac Tunnel, whenever that takes place.—*Springfield Republican.*

Knox & Lincoln.

This costly sea, coast railroad, crossing many wide and deep streams, is completed from Bath, Me., northeast to Damariscotta, about 25 miles, leaving about 20 miles to be completed to finish the road to the proposed eastern terminus at Rockland.

Omaha & Northwestern.

This company is now operating both of the "Blair roads" in Nebraska, viz., the Sioux City & Pacific, between Blair and Fremont, and the Fremont & Elkhorn Valley, from Fremont northwestward, 36 miles, to its present terminus at West Point, on the Elkhorn River, in Cuming County.

Union & Titusville.

A late number of the Titusville *Courier* says: "We were informed yesterday by persons connected with the Union & Titusville Railroad that the sale of the road (to the Oil Creek & Allegheny River Company) had been fully consummated. But last evening we were told, by one who ought to know, to the contrary, that the sale had not been made." The same paper announces the receipt of a dispatch from Philadelphia to the effect that the lease, and not the sale, of the road had been effected and the necessary papers executed. The Union & Titusville is about 25 miles long, and for nearly half its length scarcely a stone's throw from the Oil Creek & Allegheny River road. The latter is of double gauge, (6 feet and standard) the latter has the 6-feet gauge.

Bedford & Bridgeport.

Hon. John Cessna, President of this company, advertises for proposals for the grading, bridging and masonry for the extension of this road to the Maryland State line. It will altogether form an extension of the Huntingdon & Broad Top Branch of the Pennsylvania Railroad, and will connect the last named road with the Cumberland coal fields of Maryland.

West Amesbury & Newton.

This branch of the Boston & Maine Railroad from Newton, N. H., eastward five miles to West Amesbury, is just commenced.

Queen Anne's & Kent.

This railroad, which is a branch of the Delaware Railroad extending from Townsend, 29 miles south of Wilmington, south-west to the east side of Chesapeake Bay at Queenstown, is completed from Townsend to Centerville, within eight miles of Queenstown.

Joliet, Newark & Mendota.

Meetings are being held to create an interest in and encourage the giving of aid to a railroad from Joliet, Ill., nearly due west through Newark to Mendota, a distance of about 55 miles, on the line of the old American Central.

Paducah Bridge.

A special dispatch from Paducah says that all the stock in the Paducah & Illinois Bridge Company, which is authorized to construct a bridge over the Ohio at that place, was subscribed on the 31st ult. Paducah hopes to make a connection with the Cairo & Vincennes Railroad over this bridge and also with a road extend-northward and connecting with Chicago.

St. Louis & Keokuk.

The Ralls County *Record* says: "On Friday last the contract for the bridging was awarded to M. S. Cartter & Co., of St. Louis. A Howe truss is to be constructed over Salt River at a cost of $9,300, and a Queen's truss over Bear Creek at a cost of $650. Two miles of the tie contract has been let to Messrs. McFarland & Elzea, the remaining twelve miles to J. Van Ness, at an average cost of 43½ cents per tie. Mr. Smart, of Iowa, finishes up the cattle-guards and other woodwork yet to be completed. The whole of this work—bridging, ties, etc., ready for track-laying—is to be completed by the 1st of September."

New Jersey Midland.

It is expected to have this road completed to the Passaic River in September.

Kentucky & Great Eastern.

It is reported that this company expects to obtain the use of the Chesapeake & Ohio Railroad from Catlettsburg to Charleston, 55 miles, or to Greenbrier, still further, for its proposed connection across West Virginia to Washington, Baltimore, Philadelphia and New York.

Michigan Midland.

We have from an officer of the company, at St. Clair, Mich., the report of the annual meeting, held last week, at which directors and officers were elected. Their names are given in another column.

"The directors resolved to proceed with the construction of the first section of the line immediately. The following was also adopted: *Resolved*, That it is expedient to further survey the country west of Fenton, and that a line shall be run to find the most eligible location for a railway between Fenton and Three Rivers, it being deemed advisable to subject all local interests to the necessities of the shortest and best line to Chicago; and that Michael Ayer, Esq., one of our directors, is hereby appointed to consult, for information and co-operation, with the leading men between Fenton and Three Rivers, and that he shall report to this board without loss of time."

New Orleans, Mobile & Texas.

The Supreme Court of Louisiana has decided that the State Auditor must register $750,000 of State bonds in favor of the New Orleans, Mobile & Texas Railway, on the completion of the road.

Decatur & State Line.

Proposals for the masonry of the bridge over the Kankakee River for this railroad will be received at the President's office, Room 16, Bryan Block, Chicago, until noon of the 12th inst.

Painesville & Youngstown.

A correspondent informs us that work was begun on the line of this road (from Painesville, on the Lake Shore & Michigan Southern Railway 28 miles northeast of Cleveland, southeast about 60 miles) on the 27th ult. It is intended to have the cars running between Painesville and Chardon, 14 miles, by the end of this year. Engineers are locating the remainder of the line, the contracts for the construction of which are to be let as soon as it is located. S. C. Sharpless is Chief Engineer.

Orange, Alexandria & Manassas.

This company advertises for land along its route in payment of which it offers its bonds. This land it proposes to sell to immigrants.

Lake Shore & Michigan Southern.

A committee of the directors of this company were authorized at the late meeting of stockholders to decide upon the conditions of the new issue of $15,000,000 of stock. This committee consists of Horace F. Clark, Augustus Schell, and James H. Banker.

Erie Railway.

Judge Blatchford, on the 27th inst., rendered a decision denying the motion of Heath, Raphael & Co. for an injunction restraining the Erie Railway Company from issuing 30,000 additional shares of stock, the plaintiffs having failed to show that there was anything irregular in the issuing of bonds, or their conversion into stock. Judge Blatchford also decided that Jay Gould must, within sixty days, restore its registered value to 30,000 shares of Erie stock which the court has ordered him to restore to the Receiver, James H. Coleman, and denied the application of Heath & Raphael for an injunction restraining the Farmers' Loan and Trust Company from increasing the registry of Erie stock.

The Elmira *Advertiser* learns, "on reliable authority," that this company has purchased the Tioga Railroad and the Blossburg coal mines, for $2,000,000. The Tioga Railroad is connected with the Erie at Corning by the Blossburg & Corning Railroad (wholly in New York), 51½ miles long, and itself extends nearly due south from the New York line to the south part of Tioga County, Pa., to coal mines of importance. It is 34½ miles long.

Cincinnati & Great Northern.

The certificate of incorporation of this company was filed at Columbus July 23. Capital stock, $4,000,000. Corporators: A. J. Hodder, Durbin Ward, T. Wrightson, S. W. Morton and Robert Hedger. The termini of this road are Cincinnati and a point on the Ohio State line, in Williams County, north of Bryan. The route is through the following named counties: Hamilton, Butler, Warren, Preble, Montgomery, Miami, Darke, Mercer, Van Wert, Paulding, Defiance and Williams. It takes the place of the defunct Cincinnati & Mackinaw project. Books are to be opened for subscriptions to the stock on the 26th inst.

Green Bay & Lake Pepin.

This company has not been able to negotiate its bonds on reasonable terms, and consequently has not resumed work on its extension.

West Wisconsin.

The contractors on this road lost 150 laborers in one day last week on account of the better wages offered by farmers for harvest hands.

North Missouri.

Attorney-General Baker, of Missouri, having been called upon for an opinion as to the validity of the mortgage bonds for the payment of which the North Missouri Railroad is to be sold next month, replies that, without considering the inherent right of corporations to mortgage their franchises and property to secure indebtedness on their part, about which there is much conflict of opinion in the judgments of the courts of last resort in the United States, he is constrained to the opinion that this railroad company, the North Missouri, had no authority to mortgage its franchises on property without the express sanction of the Legislature, which the company did not have. He, further, is of opinion that the North Missouri Railroad Company had no authority to borrow money or pledge the main line of its road for the construction of the West Branch from Moberly to Kansas City, nor for the erection of the bridge at St. Charles, which is an enterprise owned and controlled by a distinct company. He is also of opinion that the interests of the county, as a stockholder, will be served by an application for an injunction to prevent the sale of the road, and having the mortgage declared unauthorized. Judge Henry C. Clover concurs in this opinion.

Arrangements have been made between the counsel of the North Missouri Railroad and the counsel of the County Collectors at St. Louis, by which the company agrees to pay a part of its tax bills, and is to submit the remainder for a speedy decision by the Supreme Court. In view of this agreement, Collector McGuire has withdrawn the advertisement of the sale of the rolling stock of the road.

MECHANICS AND ENGINEERING.

Northern Pacific Survey.

Mr. Thomas B. Morris, Division Engineer in charge of the Middle Division of the Northern Pacific Railroad announces that the following gentleman compose the engineering parties for that Division of the Northern Pacific Railroad.

1. Wm. Harris Kneass, Assistant Engineer, Philadelphia.
   M. A. A. Meyendorff, Transit, New York.
   G. D. Chenoweth, Level, New York.
2. James Bettner, Assistant Engineer, New York.
   Leonard Martin, Transit, Wisconsin
   Samuel Anstey, Level, England.
3. Edward Muhlenburg, Assistant Engineer, Pennsylvania.
   J. F. Logan, Transit, Pittsburgh.
   Frank Kneass, Level, Philadelphia.
4. Thomas P. Roberts Assistant Engineer, Pennsylvania.
   Jonathan Barrett, Transit, Pennsylvania.
   Ellis Clark, Jr., Level, Pennsylvania.

Division No. 1 will proceed to Fort Ellis towards Yellowstone River, thence westward towards White Tail Deer Creek, thence through Deer Lodge Pass to Hell Gate River, connecting with Division No. 4.

Division No. 2 will proceed to a point where the Dearborn Creek meets the Fort Benton route, then westward across the Cadotte Pass and Big Black Foot River, connecting with Division No. 4 near Deer Lodge City.

Division No. 3 proceeds to Fort Ellis, thence eastward to Jefferson Fork and Gallatin, then through Bozeman Pass to Yellowstone River.

Division No. 4 proceeds to Deer Lodge City, thence southwest to Hell Gate River, to Bitter Root River and Lou Lou Fork Divide.

Each of the parties have the usual complement of men—from 13 to 16—two wagons, etc. They were to leave Helena, Montana, Monday, July 21, to begin the field work.

Those of the parties that are in the least danger from Indians will have an escort and will be furnished with arms.

There are also a Minnesota Division extending from Lake Superior across Minnesota to the Red River, Gen. J. Spaulding, Division Engineer, and a Pacific Division extending from Puget Sound eastward up the Columbia River Valley.

William Milnor Roberts is Engineer in Chief of the company, and D. C. Linsley, Assistant Chief Engineer.

Bloomington Shops of the Chicago & Alton.

From the Bloomington *Pantagraph* we derive the following items:

"Eight engines are undergoing repairs.

"The Paymaster's engine is now furnished with a new boiler, and is again on the road. Major Nolton, the Paymaster, presented the boiler-shop hands with $10 each, as a compliment for doing such a good job.

"A new engine, No. 109, is being built at the shops. It is the intention to make it one of the fastest engines on the road.

"It is contemplated by the company to build a new machine shop in keeping with the balance of the shops, the present one being entirely inadequate for their business.

"A new boiler is to be placed in the blacksmith shop to run the steam hammers. Two are already in position, and the foundation is laid for five more. The heat from the furnace which heats the iron to be forged, is used for generating steam in these boilers,

"The blacksmith shop is 200 feet long and 100 feet in width, with a capacity for fifty fires. When the new shop is completed, and the trip hammers in position, the old shop will then be abandoned."

A Cross-Sectioning Device.

Mr. W. H. Robinson, of Yates City, Ill., has invented a mechanism to apply to the leveling-rod to simplify cross-section work. He describes it as follows:

This device consists of a straight rod of light wood, 1¼ inches thick, 1¾ inches wide, and 12 feet long, having a simple roller, or pulley, on each end, and a leather band twice as long as the length of the rod, drawn over the pulleys, and the ends fastened firmly and smoothly together. This band forms the face and back of the rod. It is then painted white, and graduated into feet and tenths of a foot. The graduations on the fixed part are numbered in a continuous series, from the bottom up on the side that is used in ordinary leveling to the top; thence down the opposite side to the bottom. The graduations on the band are numbered both ways from a target, or zero, one series running upward and around to the place of beginning, and the other running in the opposite direction. The figures on the fixed part, representing tenths, are painted black, and those representing feet are red. The figures on the band are also black and red, but the black ones represent tenths from the target both ways to twelve feet, while the red ones represent feet, and from thence around to the target the red figures represent tenths, and the black ones feet

The manner of using the rod is as follows: Ascertain, by using the rod as an ordinary leveling-rod, the height of the instrument (the common engineer's level) above or below grade, at the station where the observations are to be made, and set the target accordingly. The number on the face of the rod which then falls on the line of collimation of the instrument is the cut, or fill, as the case may be, at that station. If the number is below the target, it represents a cut; if above, it represents a fill. This rule is somewhat modified by the following, which the operator should be careful to remember, in order to avoid the confusion that might otherwise occur in consequence of having two columns of figures on the face of the rod: When the target is on the face of the rod the black figures are the only ones noticed as representing tenths. When the target is on the back of the rod, by reason of the instrument being more than twelve feet above grade, the numbers running from the top of the rod *downward* are the only ones noticed, and they invariably represent a *cut*. When the target is on the back of the rod, by reason of the instrument being below grade, the numbers running from the bottom of the rod *upward* are the only ones noticed, and they invariably represent a *fill*. If the instrument is more than twelve feet *above grade*, the target should be set on the back of the rod, by reference to the figures on the side opposite to the one used in ordinary leveling, If the instrument is *below grade*, the target should be set on the back of the rod, and as high as it would have to be set on the face if the instrument were above grade, instead of below. If the instrument is more than the length of the rod below, or more than twice its length above grade, the target may be set ten, twenty or thirty feet less, above or below grade, than the calculations indicate it should be set, and the ten, twenty or thirty may be added to the number read from the rod.

TRAFFIC AND EARNINGS.

—The receipts of the Great Western Railway of Canada for the week ending July 7 were:

Passengers	$37,752 46
Freight and live stock	43,887 04
Mails and sundries	2,241 34
Total	$83,880 84
Corresponding week of 1870	74,727 40
Increase (12¼ per cent.)	$ 9,153 44

—The traffic receipts of the Grand Trunk of Canada for the week ending July 8 amounted to £31,400, against £29,700 in the correponding week of last year, showing an increase of £1,700, or 5¾ per cent.

Bauschinger's Indicator Experiments on Locomotives.

One of our aims in conducting this journal has always been to keep the professional community of this country conversant with the researches of the engineering philosopher abroad, and it is for this reason that we are glad to be able to lay before our readers a record of the exhaustive indicator experiments instituted by Professor Bauschinger, of Munich, with the assistance of M. Zorn, locomotive superintendent of Augsburg, on locomotives of the Bavarian State railways. These experiments were principally conducted with a view to examining, on the one hand, the distribution of steam effected by valve motions of various classes, and, on the other hand, of ascertaining the absolute work done by the steam in comparison with the simultaneous consumption of fuel and water. We shall follow, in our notice, the course of Professor Bauschinger's work on the subject,* which is divided into four principal sections, viz.: 1. On the mode of conducting the experiments, and on the tested engines in general; 2. On the form of indicator curves; 3. On the absolute performance of steam and fuel; 4. On water and steam consumption.

TABLE NO. 1.

CLASS OF ENGINE.	Wheels. No. Total	Wheels. No. Driving wheels.	Wheels. Diameter. Driving wheels. ft. in.	Wheels. Diameter. Carryingwheels ft. in.	Weight of engine with water. tns.	Diameter of cylinders. in.	Area of pistons in square inches.	Stroke of pistons. in.	Volume of one cylinder in cubic feet.	Length of connecting rod. ft. in.	Firebox. Grate surface in square feet.	Firebox. Heating surface in square feet.	Boiler. Length. ft. in.	Boiler. Diameter. ft. in.	Boiler tubes. Number.	Boiler tubes. Length. ft. in.	Boiler tubes. Inside diameter. in.	Boiler tubes. Heating surface.	Total heating surface.	Ratio of firebox surface to tube surface.	System of valve motion	Tender. Wheels. Number.	Tender. Wheels. Diameter. ft. in.	Tender. Contents in cubic feet.	Tender. Weight with water. tns.
A	6	4	5 2	3 8	29.5	16	201	24	2.8	5 0	13	80	11 9	4 1	156	12 4	1⅞	945	1025	1-11.8	Stephenson.	6	3 0	390	20
B	Same as engine (A) except throw of eccentrics and lead.																								
C	6	2	5 0	3 0	20	13	131.5	22	1.7	5 7	9	49	12 2	4 0	126	12 8	1¼	632	681	1-13	"	4	3 0	200	14
D	6	6	4 0		34	18	254.4	26	3.8	8 11	16	83	12 10	4 1	178	13 4	1¾	1089	1079	1-13	"	6	3 0	370	20
E	6	2	5 6	3 8	22	15	176.7	22	3.2	5 6	11	52	9 8	4 0	158	10 1	1⅝	680	732	1-13	Meyer.	4	3 0	215	15
F	6	2	5 0	3 0	16	12¼	117.8	20	1.3	5 0	9 5	73	8 8	3 4	109	9 2	1¾	451	504	1-8	"	4	3 0	115	10
G	6	4	4 9	3 0	30	16	201	24	2.8	5 0	13 5	73	12 0	4 4	142	12 6	1¾	813	886	1-11	"	6	3 0	310	15
H	6	4	4 5	3 0	26	15	176 7	24	2.4	5 0	11.8	65	12 0	3 7	114	12 6	1¾	650	715	1-10	"	6	3 0	210	15

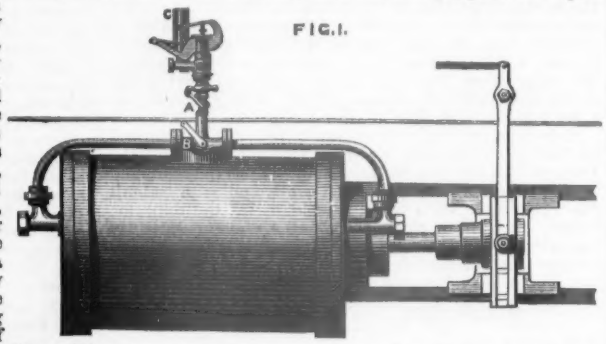
TABLE NO. 2.

CLASS OF ENGINES.	Pre-admission. In millimeters. Hind.	Front.	In per cent. of piston area. Hind.	Front	In parts of stroke. Hind.	Front.	Compression in parts of strokes. Hind.	Front.	Release. In millimeters. Hind.	Front.	In per cent. of piston area. Hind.	Front.	In parts of stroke. Hind.	Front.
E	3	0	1.1	0	1-300	1-00	1-27	1-36	0.6	3.1	0.3	1.4	1-579	1-289
F	0	3	0	1.1	1-00	1-227	1-102	1-30	5.6	2.7	2.5	1.1	1-69	1-351
G	1.5	1.5	0.6	0.6	1-1053	1-690	1-62	1-128	2.6	5.3	1.0	2.0	1-253	1-89
H 3 notch	3.7	3.7	1.4	1.4	1-187	1-127	1-25	1-16	6.3	6.3	2.3	2.3	1-48	1-70
H 2 "	4.6	4.6	1 8	1 8	1-76	1-51	1-18	1-9	7	7	2.6	2.6	1-23	1-33
H 1 "	5.2	5.2	2.0	2.0	1-36	1-23	1-7	1-4.6	7 5	7.5	2.8	2.8	1-11	1-16

1. *On the mode of conducting the Experiments and on the Tested Engines in General.*

The indicator employed by the experimenters was one of Richards's, supplied by Messrs. Elliott, of London, and was of the usual dimensions. The indicator was fixed on a three-way cock over the middle of a cylinder, as shown in the annexed Fig. 1, communicating with both cylinder ends by means of ⅜-inch copper pipes. The instrument was handled, from the engineman's foot-plate, by two rods acting upon the indicator cock, *a*, and the three-way cock, *b*, while the barrel of the instrument, *c*, was connected with the piston rod crosshead in the manner illustrated. The crosshead moved, moreover, one of Schaffer and Budenberg's stroke-counters, placed in close proximity to the experimenter, who was standing, as before stated, on the engineman's footplate. After a diagram had been drawn, the connection between the indicator barrel and piston rod crosshead could be loosened, and an arrangement was also provided for enabling several curves to be taken, on one and the same paper, without mounting a new sheet on the barrel. As a rule a new diagram was registered for each change in the position of either the regulator, the reversing lever, the expansion hand (in the case of Meyer's valve motion), or the blast pipe orifice. We readily admit that the method of taking the diagrams from the foot-plate permits of a more uniform system of observation, nevertheless we should ourselves give the preference to the plan in which the operator places himself beside the indicator; and we prefer this latter way of proceeding, on account of its enabling a far greater number of diagrams to be taken within a given time than the other method, and also on account of its not depending so much on the working of gear, which, at any time, may go wrong.

FIG. 1.



In the trial under notice the speed of the engine was measured and registered by means of a chronometer, the period during which the regulator and the reversing lever remained unchanged was also carefully noted down, and in order to arrive at the corresponding number of revolutions of the drivers at the same intervals, from minute to minute, the state of the stroke counter was registered, as was also the boiler pressure. The feed water was measured by a glass gauge fixed on the tender, and the fuel was weighed. We are glad to be told by Professor Bauschinger—and this enhances greatly the practical value of the trials—that the engines were experimented upon in their normal condition, and while doing their ordinary work. It too frequently happens that in trials of this kind the duties of the engineman are interfered with or rendered perplexed by contrary orders, but we are told that this was not the case, and that the drivers were merely ordered to aim at maintaining the proper water level and boiler pressure.

The valve gear of the engines running on the Bavarian State railways is partly of the shifting-link, or Stephenson class, and partly on a system of double-valve motion, known on the Continent as Meyer's motion. Of each category four engines were selected for trial, and of these engines we give the leading dimensions in the Table No. 1. They were all with outside cylinders, three being express, two goods, and the rest mixed engines. Two of the engines were fitted with Allen's or Trick's double admission valve, and it will be seen in the course of our epitome of the professor's investigations, that this valve shows very good results in connection with the shifting-link motion. In the case of Meyer's motion, the main or distribution valves are moved by the reversing links; but these are not used for expansion purposes, the reversing lever being either put full forward or fully thrown back. The eccentrics of the expansion valves are set at an angle of lead of 180°. Before we proceed to examine the indicator curves obtained by Professor Bauschinger we give, in Table No. 2, some figures taken from a diagram relating to the action of the main valves of the four engines with Meyer's valve gear.

It will be noticed by examining this table, that in the case of the fourth engine (H) the table contains the values corresponding to *three* positions of the reversing lever, this being the only cases in which the distribution valves were also used for the purpose of expansion. In concluding our notes on the engines tested, we should state that, with the exception of engine (H), all were supplied with variable exhaust gear, worked from the engineman's foot-plate, and by means of which the blast-pipe orifice could gradually be contracted. The annexed Figs 2 and 3, illustrate the two different arrangements adopted.—*Engineering.*

(TO BE CONTINUED.)

* Indicator Versuche an Locomotiven, angestellt unter Mitwirkung des konigl. Maschinenmeisters Zorn in Augsburg und bearbeitet von Joh. Bauschinger, Konigl. Professor am Realgymnasium in Munchen.

The London Underground Railroad.

The completion of the final section of the Metropolitan District Railway of London has given occasion to *The Engineer* to make some interesting comments on the construction of this line:

"The idea of carrying intramural railways under ground was a fortunate conception for London. That such a thing was practicable, could only be demonstrated by actually doing it. It has been done by Mr. Fowler to an extent which gives him a foremost place among engineers. To carry a line across Chat Moss were a simpler matter, despite its stupendous scale, than to drive a tunnel through the entanglements of gas and water mains, sewers, cellars, subways, and foundations, which form a species of jungle in the underground topography of the metropolis. Every inch of the way is beset with difficulties, something like those which encompass the surgeon in seeking to perform some delicate operation amid the mazes of arteries and organs which crowd the anatomy of the human body. The works of the underground railway are not merely complicated, but great strength is required in most of the structural parts, the burden in some instances being enormous. What is to be thought of carrying the railway below the vaults and subways of Queen Victoria street, one set of girders being required to support the vaults and subways above the railway, and another set of girders to support the road above the subways! In some parts of the line the breaking weight of each column is estimated at 2,000 tons. Even the church of St. Nicholas is supported by the works connected with the railway, the original

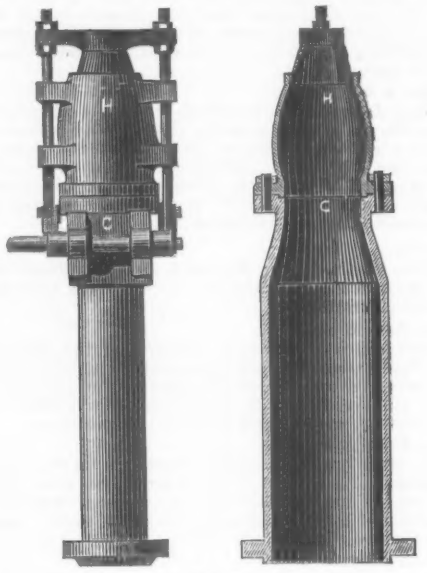


Fig. 2.

foundations of the edifice being extended downward for a depth of 40 feet. These and numerous other facts connected with the undertaking mark its peculiar character, and establish its claim to be considered an extraordinary engineering achievement. * * *

"When the Metropolitan Railway from Farringdon road to Paddington was first opened trains ran at intervals of 20 minutes; now it is a common occurrence for thirty trains to pass a given point within an hour. In 1863 the Metropolitan Railway carried 9,455,175 passengers; in 1870 the number carried on the Metropolitan and Metropolitan District Railways was 39,160,849. The receipts on the District line have increased in very high ratio within the last twelve months, and the extension to the Mansion House will unquestionably hove a great effect in augmenting the traffic. Facilities for traveling always increases the number of travelers, and the effect reacts on the cause." * * * *

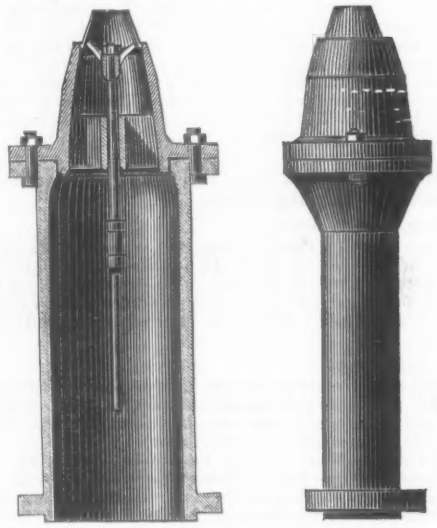


Fig. 3.

—The acting Secretary of the Interior, following the advice of Assistant Attorney-General Smith, holds that, in adjusting grants of lands to railroads where the grants lap, the road that first definitely located its line has the best claim to the lands, and until the location of the line the grant is in the nature of a floating grant, and does not attach to any specific lands until the line is definitely fixed.

—A great coal shipping station is to be established at Perth Amboy, N. J. Robert H. Sayre, of the Lehigh Valley Railroad, has purchased 300 acres, with an extensive water front, at that place, it is said, for the Reading as well as his own road. It is proposed to connect the West Line Railroad of New Jersey with Perth Amboy by constructing a branch line from Milburn.

—The Rochester *Democrat* is slightly sarcastic on a railroad line in that vicinity. It says that a gentleman took the train, a few days since, on what is termed "the huckleberry road," running between Avon and Mount Morris. After the train had started from Avon he discovered that he had left a valuable dog behind, but on arriving at Mount Morris, the lost dog was found sitting at the station awaiting the arrival of his master.